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The ELECTRICAL REVIEW is not in the habit of calling attention to its own accomplishments. On rare occasions we have done this. We believe our readers will pardon us if we take this opportunity to express our thanks to the appreciative numbers who have written to us within recent days complimenting this journal on its sustained development. The very complete and unique review of the various sections of the International Electrical Congress, which we presented last week, is evidently considered of particular merit, and the many communications we have received all bring words of praise for not only this report, but for the general quality and enterprise of this journal. We conclude, in this issue, the special matter relating to the International Electrical Congress with a full-page portrait of the members, suitable for preservation.

In this relation, the ELECTRICAL REVIEW desires to present the thanks of its staff to the expert contributors who so ably and graphically presented the doings of this great electrical gathering—probably the most influential and important ever held.

INTEREST IN SINGLE-PHASE MOTORS.

Of all the different applications of electricity, the electric railway seems to attract the most attention. There are many reasons why this should be so, one being the great activity which has prevailed in this field since the first commercially successful electric road. Then, again, no one can say definitely where this use of the electric motor in traction will end, and what effect it will have on the large railway systems, and anything touching the interest of the large railways is always of more or less interest to the general public. At the present time, however, the attention of engineers and others is focused on the electric railway because so many of the important electric manufacturing companies have but recently brought out traction motors of a type which, until recently, was thought to be impracticable.

We have already described the motor designed by the General Electric Company. The Westinghouse motor was described some time since. Due, however, to financial difficulties connected with the ill-fated Baltimore-Washington line, the equipments built for that system by the Westinghouse company were never put into service. One of these equipments was exhibited on the occasion of the visit to Pittsburg of the American Institute of Electrical Engineers and its foreign guests. The car ran beautifully, and the commutation of the motors on the car, as well as the one in the shop—which was heavily overloaded—was certainly excellent. As it is this question of commutation which formerly was the most troublesome problem to solve in producing a satisfactory commutator motor for alternating currents, the performance of these machines should do much toward giving railway engineers confidence in the newly developed type.

A number of single-phase alternating-current commutating motors have been brought out in Europe. We may mention the Finzi and the Eichberg-Winter, which were designed for railway work. Now the Oerlikon Company announces that it has developed a single-phase commutating motor suitable for traction. From the incomplete descriptions available at this time there would seem to be but little difference between this motor and that brought out by the General Electric Company. Both have distributed windings on stator and rotor, one section of the stator winding acting to nullify the armature reaction. The Oerlikon motor, from the accounts at hand, may be operated in a number of ways, but its operation is most satisfactory as a simple direct-current series motor, and next as a series compensated alternating-current motor. Whether the Oerlikon Company believes that the single-phase commutating motor will be used in railway work, to the exclusion of the polyphase induction motor, does not appear from

the reports, but it is at least apparent that this important and influential company realizes the necessity of offering a motor of this type.

One point in the operation of the single-phase commutating motor is interesting. In traction work it is essential that the motor be able to develop a large starting torque. Here the series continuous-current motor excels, but the single-phase commutator motor is not far behind, and it has one advantage over the former. The torque of a motor is independent of the speed and of the work performed. It is merely a question of field strength and armature current, and a proper phase relation between these two factors. In starting the continuous-current motor the necessary torque is given by a voltage considerably less than that of the system, and the excess voltage must be absorbed in a rheostat. In the single-phase commutating motor this excess voltage may be largely balanced by the counter-electromotive force due to the inductance of the motor, so that the starting losses of the continuous-current motor are largely avoided in the alternating-current motor. This is not true in regard to induction motors, because in these machines, while we may have heavy currents flowing in the rotor, and a strong field existing in the stator, the motor currents and the stator field are not in phase; hence, the poor starting torque of these motors. With the commutating motor of the compensated type the armature reaction is neutralized. The direction of the field is fixed by the position of the field coils, and the relation of the armature currents to this field is determined by the position of the brushes. The field flux is, of course, in phase with the field current, and since this is a series motor, the armature current is in phase with the field flux. Thus, there is no reduction of starting torque due to the armature reaction, and the low power-factor of the motor at starting is rather an advantage than otherwise.

The general interest in this field of railway work was manifested at the recent International Electrical Congress, where this topic received more attention than any other. It was the subject of the president's annual address, and was chosen as the topic for joint discussion by the American Institute of Electrical Engineers and the Institution of Electrical Engineers, of Great Britain. It also occupied a good part of the attention of section F (electric transportation), and in the joint session between this section and section B (general application), the discussion of alternating-current motors seemed to be conducted with particular regard to their use in railway work.

Although there is as yet in this country no railroad operating commercially with alternating-current motors, the work of installing several such equipments is in progress, and practical results will soon be obtainable. An interesting phase of the subject is the recognition which the commutating alternating-current motor has received—a machine which but a few years ago was mentioned only as interesting theoretically. Now a number of large manufacturing companies have developed commercial apparatus before a single road has been put into service.

THE CARBON CELL.

One of the papers read at the recent International Electrical Congress, St. Louis, Mo., was by Dr. F. Haber and Dr. L. Bruner, on "The Carbon Cell." This paper was of more than academic interest, for by the "carbon cell" is meant that device which was invented in an attempt to produce electricity directly from coal. Various forms of this cell have been invented, but perhaps the best known example is that devised by Dr. W. W. Jacques. It consists of an iron vessel containing as an electrolyte fused caustic potash, and as an anode a rod of carbon. The iron pot itself forms the cathode. When forcing air through the electrolyte a potential a little less than one volt was developed, and with suitably arranged apparatus large currents could be obtained.

The apparatus, at the time it was suggested, excited a great deal of interest, but it was found that as a generator of electricity it could not compete with the mechanically driven dynamo. In a critical study of this device Mr. C. J. Reed showed that it was not a carbon-consuming cell, as the carbon electrode could be replaced by almost any conductor without affecting the result. It was thought that the electrical energy given out was produced by a thermo-electromotive force. He therefore called it a thermal cell, by which designation it has since been known. While Reed's investigation seemed to condemn the cell as a commercial apparatus, the conclusion reached that the potential was due to thermal electromotive forces was interesting, as all known thermal electromotive forces were, in comparison, minute. A thermoelectric junction of two metals, under practical conditions, gives but a few hundredths of a volt per junction. The Jacques combination gives 0.9 volt per cell.

In the paper referred to above it is demonstrated that Reed's conclusion is incorrect. The electromotive force given by the Jacques cell is due to chemical action. The authors show, first, that, due to the presence of manganese salts in small quantities, the iron electrode becomes oxidized and acts as an oxygen electrode. It is only necessary for the manganese to be present as an impurity either in the electrolyte or in the iron itself. If we remember correctly, Dr. Jacques, in his cell, added a manganese salt to his electrolyte, but he attributed a different action to it. He thought that it prevented the formation of potasium carbonate by the combination of the potasium hydrate and the carbon dioxide which was supposed to be given off from the oxidation of the carbon electrode.

At the carbon electrode, according to Drs. Haber and Bruner, there is first a decomposition of the electrolyte due to the carbon. This action sets free hydrogen. This, in effect, produces a hydrogen anode, and the electromotive force of the cell is due to a hydrogen-oxygen couple. It is pointed out that this production of hydrogen is accompanied by a disintegration of the carbon electrode, the two actions being more or less dependent. This accounts for Dr. Jacques's statement, that the consumption of carbon in the cell was proportional to the ampere-hours delivered.

The conclusion reached in the paper referred to above is

that the cell is without importance from the practical standpoint, because during its action the valuable carbon electrode and the expensive sodium hydrate are changed into cheap soda, only to obtain a little hydrogen, which acts electromotively.

From the theoretical standpoint, however, the cell is important, but, aside from this, this paper is of interest because many minds are dwelling upon the possibility of a true carbon-consuming cell; and the explanation of the failure of this attempt teaches us that no simple modification of Jacques's method would bring about the desired result, and we must seek in other directions.

A RETURN TO STOVES.

It is announced that the Public Service Corporation of New Jersey, a company controlling a number of electric traction lines in and about Jersey City, has decided to change the heating system now in use on its electric cars. It is said, in explanation, that during last winter when the weather was extremely severe it was found impossible to operate the cars satisfactorily and, at the same time, keep them comfortable by means of electric heaters. In many instances the electric heaters were shut off, because the supply of power was insufficient both for running the cars and heating them. To avoid a similar situation next winter this company, it is said, will take out all electric heaters and replace them with coal-burning stoves. In the announcement of the change, stress is laid upon the expense of the electric heaters and the cost of operating them. Certain of the cars seem to have been fitted with a hot-water system, but this is to be done away with also; nothing but stoves will be used.

Without questioning the statement that it is more expensive to heat cars electrically than by means of a coal stove, the fact that it may cost more is not the only—nor, indeed, the most important—thing to be considered. The stoves will occupy a certain amount of room, and will thus detract from the earning capacity of the cars. They will introduce a certain amount of danger, particularly in case of accidents. The electric heaters are perfectly safe and take up no valuable space, and, moreover, they are always ready to be put into service. The latter feature is of particular importance in the spring and fall. The electric heaters are clean, easily controlled, and do not introduce a new system on the car. In other places, the use of electric heating and cooking apparatus is growing rapidly, because of the cleanliness and convenience of this method; and if there is any place where electric heaters seem to be the proper thing, it is on an electric car.

It is argued that the use of stoves, by removing the heater load on the station, will enable the cars to be operated more satisfactorily. Possibly so, but would it not have been better to provide for the extra power needed, rather than to return to the primitive stove? Surely, there has been plenty of time since cold weather to arrange for increased station capacity.

There is one stage in the heating of electric cars where some system other than electricity might be used to advantage. This is getting the car ready for its first trip. At present, cars are either sent out unheated or the heaters are turned on some time before the start is made. While cars are standing in the barn, there is no particular reason for heating them electrically, except that they are provided with electric heaters. Why would it not be a good plan to arrange steam pipes on the cars and perform this preliminary heating by means of steam? There should be no great difficulty in installing the pipes, and if the car-barn is near the power station the steam itself would cost little or nothing. In this way cars could be sent out comfortably heated, not only without throwing an undesirable load on the generators, but with less wear and tear upon the heaters. When a car is heated for the first time it is desirable to do this as rapidly as possible; but this not only increases the demand on the station, but it is more severe on the heater itself. In case the car-barn is not near the power station, preliminary heating by steam would require a boiler plant, but this plant could also be employed to heat the building, and the cost chargeable to the cars would not be great.

There is another question in regard to the use of steam yet to be answered: how will the state authorities view the change? They have been to considerable trouble to banish stoves from railway trains, and it is hardly probable that they will view with favor their reintroduction on electric cars.

THE NEW YORK STATE STREET RAILWAY CONVENTION.

The value of conventions for the meeting of members of allied interests and the discussion of topics connected therewith is evident and need not be here dwelt upon. In the convention held recently at Utica, perhaps the most valuable feature was the discussion which followed the reading of the various papers. The carrying of express matter by traction lines is a new and developing source of revenue for them, and received appropriate consideration. The report of the committee appointed to investigate the danger of high-voltage lines was one of the most valuable papers submitted. The committee had carefully gone over the problem and its recommendations are of great interest, not only to the generators and users of electric power, but also to the general public. The results of the committee's experiments were interesting in exploding a number of fallacies, among them that there is danger of an electric current passing back over a stream of water from a high-tension wire to the hose or nozzle. The experiment was even continued up to a voltage of 20,000 without showing any appreciable current either through instrument or persons. The convention was wise in continuing the investigation of the committee for another year.

The Utica & Mohawk Valley Railway Company has probably struck upon one solution of the labor difficulty. The employés of this company are a satisfied lot and look refreshingly intelligent and neat. They have a club house and gymnasium and an organization in which, by the payment of a monthly sum, they are insured sick benefits. The company has extended financial aid to them and stands ready to continue it in the future in case of necessity. An attempt to organize a union among the employés some time ago was frustrated, chiefly through the efforts and support of the old employés of the company.

THE CARBON CELL.[1]

BY DR. F. HABER AND DR. L. BRUNER.

Among the various attempts to construct galvanic cells in which an electric current is produced by the consumption of carbon, there is none that has been of greater interest than the experiment of Jacques, who proposed the cell consisting of the following:

Carbon — fused sodium hydrate — iron.

This cell has been the subject of experiments by numerous investigators, especially Mr. C. J. Reed in America, and Messrs. Liebenow and Strasser in Germany. Experiments which we ourselves have conducted show that the true nature of this cell is different from what it was supposed to be.

Let us consider first the behavior of each of the electrodes separately.

The iron electrode in the fused sodium hydrate is gradually covered with a protecting layer or skin of the oxide. As soon as this has been produced, the iron is no longer attacked, while previously it went into solution in the fused salt as iron oxide, with the development of hydrogen gas. This protecting skin can be produced rapidly if the iron is dipped for a short time into fused saltpetre, and subsequently carefully freed from the saltpetre by means of water.

The iron thus coated with this protecting skin is called "passive," because the fused sodium hydrate produces no further changes on it.

This passive iron represents an oxygen electrode on which the atmospheric oxygen acts similarly, but better, than on a platinized platinum electrode dipped into an aqueous conducting solution. This action of the oxygen is brought about by the presence of sodium manganate, which is always present in small quantities in fused commercial sodium hydrate, and especially when in contact with iron, and its presence can easily be proved chemically. Quite pure sodium hydrate, when fused and in contact with commercial iron, will contain some manganese because a small quantity of manganese forms a normal part of commercial iron and gets into the fused salt when the iron is attacked by the sodium hydrate previously to the production of the passive state; by means of the atmospheric air it becomes a manganate.

The passive iron, as an unattackable electrode, can be replaced by another indifferent electrode, as for instance by platinum, and without changing the force and the method of action of the electrode in fused sodium hydrate containing manganese.

If platinum is placed in pure sodium hydrate the potential at the electrode is uncertain. A very small quantity of a manganate suffices to give rise to a different value, which does not change during a further addition of a manganate up to two per cent of the weight of the sodium hydrate.

If the added sodium manganate is reduced by forcing in some hydrogen or carbon monoxide, or by the addition of sodium oxalate or sodium formate, quite an extraordinary change will take place in the potential. But by forcing in some atmospheric oxygen the original value of the potential is again reached.

In these experiments the potential of the platinum electrode is thus brought about by the absorption of oxygen. If a permanganate is added to fused sodium hydrate, oxygen will be evolved and the potential will, contrary to the other case, be brought about by the evolution of oxygen. These potentials are measured most simply by letting the syphon of a decinormal-electrode terminate in a small vessel containing concentrated sodium hydrate, which is in electric contact with the fused salt which is to be tested, by means of a rod of solid sodium hydrate. In all the measurements the fused salt was in a large silver crucible. The observed values are collected in the following table for different temperatures. The temperature was measured thermoelectrically.

Centigrade degrees	312	336	360	388	412	472	532
Potential in volts against decinormal-electrode	—0.265	—0.294	—0.314	—0.333	—0.353	—0.431	—0.472

These values were measured with a platinum electrode, a small quantity of the manganate being added to the sodium hydrate. Numerous tests showed that absolutely equal values of the potential are obtained with an electrode of passive iron. An earlier opinion from other sources, namely, that the presence of certain steps in the oxidation of the iron in the fused salt is of importance in the behavior of this electrode, is not proved to be correct.

Let us now consider the carbon electrode.

When a carbon electrode is tested in the way above described for iron and platinum, all possible values can be observed between — 0.6 and — 1.5 volts toward the decinormal-electrode. With closer study one finds that the potential approaches the value — 1.5 volts more and more, the more rapidly the carbon is attacked in the fused sodium hydrate with the evolution of gas. This attack is less the denser and the more graphitic the carbon is. Electrodes which are treated by the process of the International Acheson Graphite Company, therefore, remain very far from this value, — 1.5 volts. Ordinary arc light carbon, on the other hand, can generally be made to produce a free gas evolution when the fused salt in which it is dipped is heated to above 500 degrees centigrade. They then reach quite or nearly the value — 1.5 volts and remain at this value when the fused salt in which they are dipped is cooled to the point of solidification. But as the accompanying evolution of gas gradually diminishes at a lower temperature (about 350 degrees), the potential will simultaneously change; it will diminish to the values — 1.3 or — 1.2 volts, etc.

The gas which the carbon electrode evolves in the hot fused sodium hydrate is hydrogen gas.

If, instead of the carbon electrode, a platinum tube is dipped into the fused sodium hydrate, and pure hydrogen gas is led through it into the liquid, one obtains with a strong current of gas the potential — 1.5 volts, and this will be the case at all temperatures between 500 degrees and the point of solidification of the fused salt. If the current of hydrogen gas is made weaker, the value — 1.5 volts will not be reached; the figures will be smaller. The potential of the carbon in the fused sodium hydrate is, according to this, not determined directly by the carbon, but by the hydrogen which the action of the carbon on the fused salt sets free. The temperature produces no effect on the potential within the given wide range, but the rapidity of the evolution of the hydrogen is of great importance.

Before we recognized this connection between the two, we had held a different conception concerning the process at the carbon electrode. We supposed that a formic acid salt or an oxalic acid salt, or carbon monoxide were produced, and that these materials determined the potential at the carbon electrode. We, therefore, tested the action which an addition of the two named salts or the introduction of carbon monoxide had on the fused salt, and on the behavior of the platinum elec-

[1] Presented before section C—electrochemistry—at the International Electrical Congress, St. Louis, 1904.

trode which is dipped into the fused salt. We found by chemical investigations that former statements in the literature were confirmed, according to which oxalates and formates in an excess of fused sodium hydrate, pass over freely into carbonate and hydrogen gas. Formates may be assumed to be a combination of carbon monoxide with sodium hydrate, and oxalates may be assumed to be a combination of carbon monoxide with an alkali carbonate. We assumed, therefore, that carbon monoxide with sodium hydrate could also produce hydrogen and sodium carbonate. We found this to be definitely proved to be a fact, when we led carbon monoxide through a silver spiral heated to 350 degrees, in which there was fused sodium hydrate. The following reaction is thereby obtained with great ease:

$$CO + 2NaOH = CO_3Na_2 + H_2.$$

It can be proved by means of thermodynamics, that the oxalate, the formate and carbon monoxide, when they act as such on the electrode, should manifest their potentials, which exceed — 1.5 volts. Such potentials, however, were never observed. On the other hand, it was found that all three materials as such were inactive at the electrode, and that it was only the hydrogen evolved by them which charged them and brought their potential more or less close to the value — 1.5 volts, according to the rapidity of the release of the gas. According to these principles we are in a position to say that the so-called Jacques carbon cell is a hydrogen-oxygen chain, in which the oxygen of the air, by the intermediate action of the manganates at the iron electrode, acts with the hydrogen released by the carbon from the fused salt at the other electrode. The power of this element depends on the consistency of the carbon. If the latter is loose and capable of producing hydrogen gas evolution, one obtains those values which are found when one deducts — 1.5 volts from the above-mentioned values for the oxygen electrode. As for instance (— 0.265 + 1.5), that is, + 1.24 volts at 312 degrees centigrade, and (— 0.472 + 1.5), that is, + 1.03 volts at 532 degrees centigrade.

Thermoelectric phenomena take no part in the production of these electromotive actions. For these forces do not depend in the least on the materials iron and carbon, but only on the gases oxygen and hydrogen, and the same platinum tube shows alternately the force of the iron and the carbon electrode, if at constant temperature we pass through it oxygen and hydrogen respectively.

The element under discussion is without importance from the practical standpoint, because during its action the valuable carbon electrode and the equally expensive sodium hydrate are changed into cheap soda, only to obtain a little hydrogen which acts electromotively.

From the theoretical standpoint such a hydrogen-oxygen chain offers much of importance. It is differentiated from the old well-known Grove hydrogen-oxygen chain, in that it is not liquid water, but a solution of water in fused sodium hydrate, which is produced by its action.

The relation which Helmholtz has proved for the connection between the electromotive force of reversible galvanic chains, and the reaction heat of the process which produces the current, enables us to calculate the heat of reaction in the present case. This is shown to be 81,650 gramme calories per gramme molecule of water produced. But as the formation of a gramme molecule of water vapor at the range of temperatures of the experiment sets free approximately 58,650 gramme calories, it follows that the evolution of heat which accompanies the absorption of the gramme molecule of water vapor by a very large quantity of fused sodium hydrate has a value of approximately 23,000 gramme calories. This high value arises from the fact that fused sodium hydrate holds the last traces of water with unusual tenacity, as has already been shown by others.

One can carry out the theoretical conception on the basis of the Helmholtz relation above given, in still another way. One can, for instance, suppose at the start that an equilibrium exists between a fused salt containing water, and the vapor pressure of the water above it. In this way one arrives at the conception that the action of our chain depends on the change of the atmospheric oxygen, which has a pressure of 0.2 atmosphere, and the hydrogen which has an atmospheric pressure, into water vapor of a pressure corresponding to the state of equilibrium above the water containing the fused salt. When we integrate the above-mentioned differential equation of Helmholtz, and for comparison consider the known values of the force of the Grove gas chain, we can calculate the vapor pressure above the fused sodium hydrate at different temperatures. The carrying out of these theoretical calculations requires a more extended representation of the case and this departs too far from the intention of this discussion to be embodied here. One can find it in an extended treatment of the subject which will appear in the German language in the *Zeitschrift für Elektrochemie*. The result of the calculations is that the vapor pressure above fused sodium hydrate at 300 degrees is extremely small and increases with increasing temperature. The fused mass is, therefore, especially hygroscopic near its point of solidification, and the force of the hydrogen-oxygen chain at this temperature is the highest. That the force of the Jacques carbon cell increases with the temperature is not in contradiction with this, but is explained according to our former statement by the fact that the evolution of hydrogen by the carbon increases in rapidity very quickly with increasing temperature.

School for Employees of Electrical Plants.

Consular agent, Southard P. Warner, writes from Gera, Germany, that a few months ago the Central Trades Association of Königsberg, Prussia, instituted a free course of instruction for those who are employed at the electrical works in that city (minors excepted). The lectures, which are held two evenings a week, from half past seven until half past nine, are delivered by some expert engineer, who has had long practical experience. At the end of each course, which lasts about twelve weeks, examinations are held. Those who succeed in passing these examinations are awarded certificates which set forth the fact that they have performed their work in a satisfactory manner.

It is thought that this idea of giving free instruction to the employés of electrical works will be introduced in other places, as it is very much to be desired that workmen know as much about the business as possible, not only because they will be more efficient, but also in order to lessen the possibility of accidents.

Plan to Prevent Electrolysis.

Some time ago a damage suit instituted by the city of St. Paul against the Twin City Rapid Transit Company, Minneapolis and St. Paul, was suspended with the promise that the company would present a scheme for the prevention of damage to the city water mains by electrolysis. The Transit company has now submitted a detailed plan prepared by Sargent & Lundy, of Chicago. It provides for the return of the current by a cable connected with the rails and laid between the double tracks. Professor Dugald C. Jackson, University of Wisconsin, will examine the plan and report its value to the commissioners.

The Electric Power-Transmission Plant at the Waterfalls of Kykkelsrud, Norway.

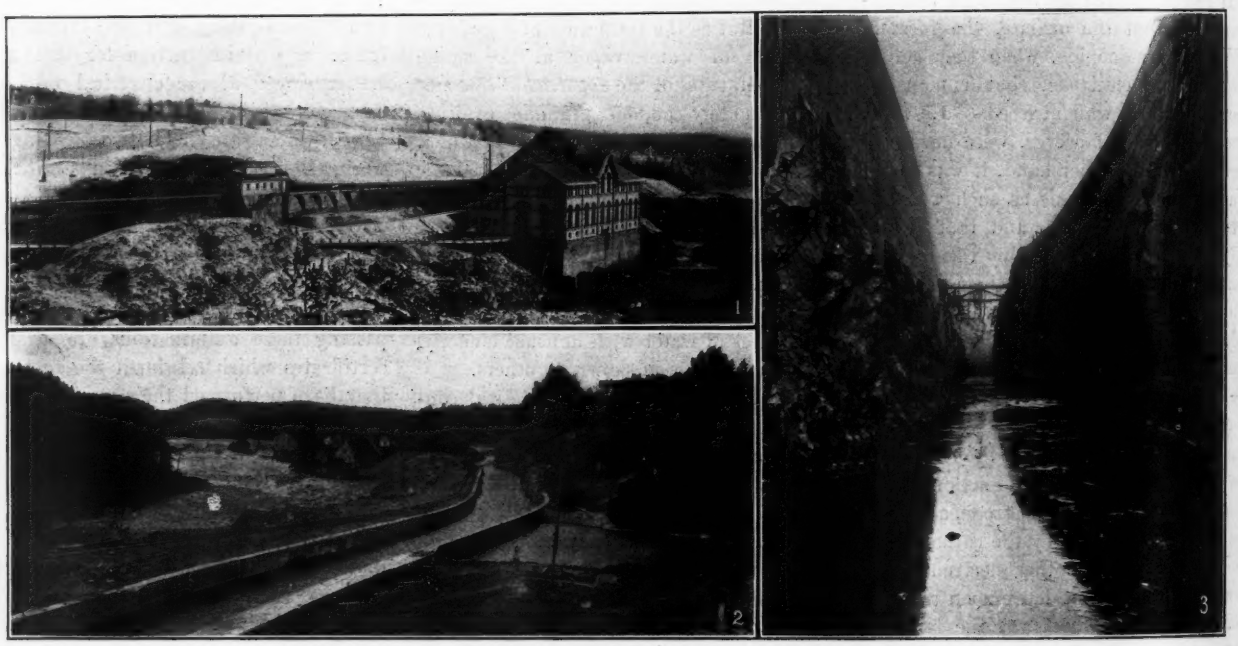
By Einar Boye.

THE largest water-course in Norway, the river Glommen, which rises high in the mountains and has a basin of about 40,000 square kilometres (about 5,500 square miles), has a number of waterfalls in the last sixty kilometres (forty miles) of its course before it discharges into Skagerak. The largest of these, the Kykkelsrud falls, are in the neighborhood of the Askim railroad station in the district of Smaalenene (the southeastern part of Norway). Strictly speaking there are three rapids at Kykkelsrud, which by proper damming make the available height of the falls at low water 19.2 metres (sixty-two feet).

The place selected for the dam is exceptionally suitable, because a small island just above the falls divides the river into two channels, making it easy to shut off one of them, while the dam was being built. Only one channel is as yet dammed, as the water thus obtained is sufficient to develop 12,000 horse-power, which is all that is needed at present. This also leaves the other channel to take care of the floating timber, of which there is a large amount.

The dam and intake to the water supply channel are situated 1,000 metres (3,280 feet) from the power-house. The water is let into the channel through two locks of the channel is about twenty-six metres (85.6 feet) wide by 120 metres (394 feet) long; from here the water is led to the turbines, partly through channels blasted in the rock, partly through concrete tunnels and partly through steel pipes.

To prevent foreign matter from entering the turbines iron gratings are placed in front of the gates at the inlet by the dam and at the distributing basin. The latter is also placed about 0.5 metre (one and one-half feet) higher than the end of the channel, making a settling chamber for stones, sand and so forth. The channel can be emptied through a sluiceway twenty-eight square metres (301 square



THE ELECTRIC POWER-TRANSMISSION PLANT AT KYKKELSRUD, NORWAY.
1.—Power-House. 2.—Canal, Wood-Pulp Factory and Principal Falls. 3.—Part of the Canal.

The average rate of flow of the Glommen river is 250 cubic metres (660,000 gallons) per second, while during floods as much as 4,500 cubic metres (1,200,000 gallons) have been observed.

At Kykkelsrud there was originally a wood-pulp factory, a sawmill and a flour-mill, but some three years ago the stock company owning the property—the Glommen Træsliberi (wood-grinding factory)—made arrangements with the German firm Elektricitäts-Aktien-Gesellschaft, formerly Schuckert & Company, of Nürnberg, to build a water-power plant with a capacity of 45,000 horse-power and an electric transmission plant of 9,000 horse-power.

with five gates each; the gates are of solid pine timber and the arrangement is such that they can be operated separately or all at the same time—either electrically or by hand.

The first 100 metres (328 feet) of the channel nearest the reservoir is twenty-five metres (82 feet) wide, with a slope of 3.9 per cent, the last 900 metres (2,952 feet) is eight metres (twenty-six feet) wide with a slope of one per cent.

The channel, which is from ten to fifteen metres (thirty-three feet to forty-nine feet) deep, is blasted through solid rock through almost its entire length and the sides lined with concrete.

The distributing reservoir at the end feet) in front of the reservoir and floating ice disposed of through a gate at the end of the same.

The present power-house is built for four turbines for the generators rated at 3,000 horse-power each and three smaller ones (two of 280 to 300 horse-power and one of 500 horse-power) for driving direct-current dynamos for magnetizing, station lighting and other minor purposes. As stated above, however, the water-power plant is designed for a total capacity of 45,000 horse-power and it is the intention later on, as the demand increases, to make additions to the power-house and install eight additional turbines of 5,000 horse-power each, making a total installed

capacity—turbines for direct-current dynamos included—of about 53,000 horse-power. Of this amount, however, only about 43,500 horse-power can be used at this time, leaving the balance as reserve. When completed, this will be the largest water-power plant in Europe.

The present power-house, which is close to the distributing reservoir, is a handsome brick building, 46.5 metres long by 26.5 metres wide (152½ feet by 87 feet). The foundations are set in concrete. The pipes for the 3,000-horse-power turbines are also of concrete, while steel pipes are used for the smaller units. In the basement are placed all the turbines and two forty-horse-power electromotors for the oil pumps, which deliver oil under a pressure of thirty atmospheres (440 pounds per square inch) for the large generator bearings and the automatic turbine-regulators. Vertical shafts, 8.5 metres (twenty-eight feet) long, extend to the generators located on the floor above.

At present there are in place two turbines of 3,000 and two of 280 horse-power each. One of the two largest was built by Escher Wyss & Company, Zürich, Switzerland, the other large one and the two small ones by J. M. Voith, Heidenheim, Würtenburg. The two large turbines have a guaranteed total efficiency of seventy-five per cent at full load and develop 3,000 horse-power at 150 revolutions per minute under a head of sixteen metres (52.48 feet) and eighteen cubic metres (4,755 gallons) of water per second. The size of the inlet tube is three metres (9.84 feet).

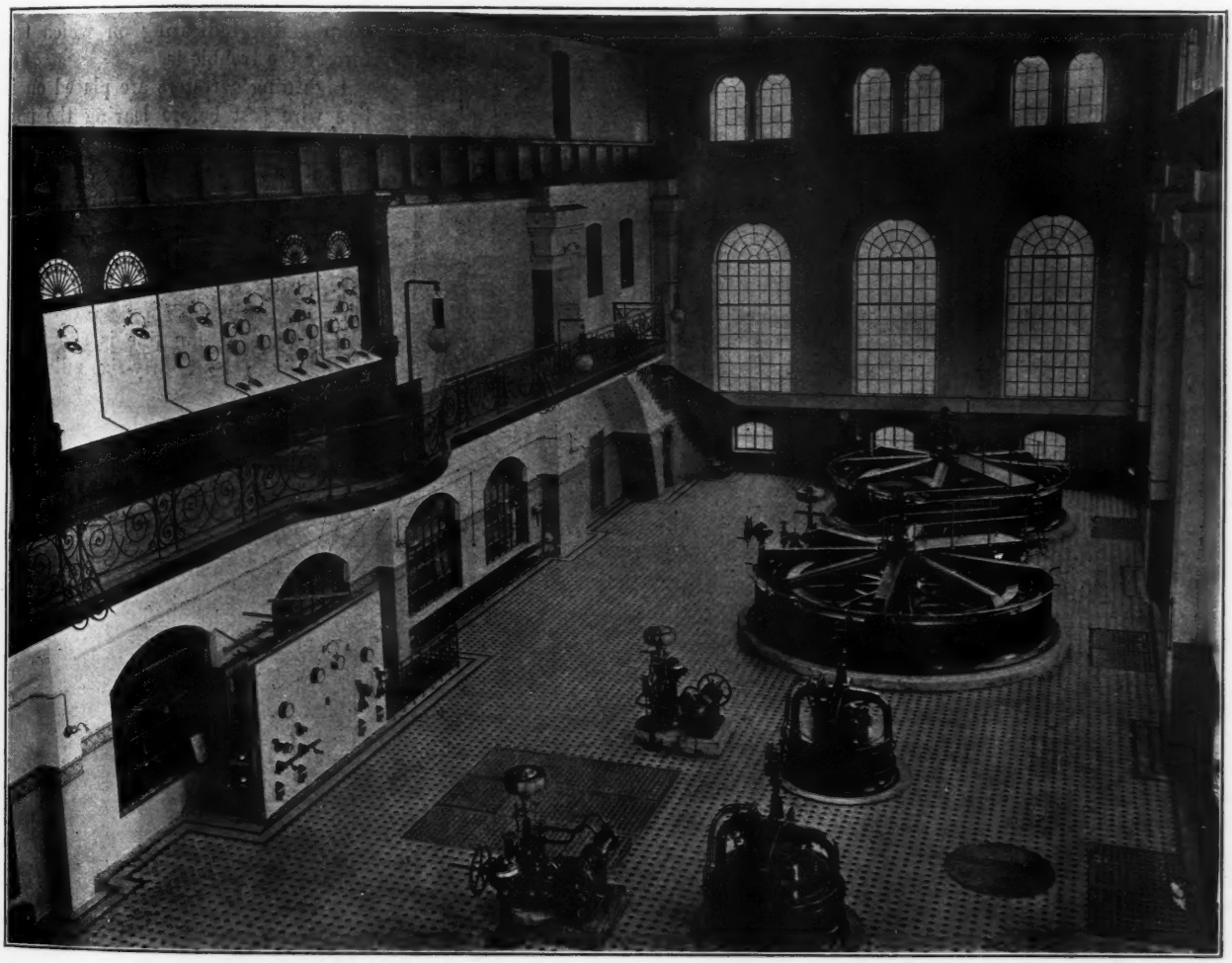
The weight of the rotating parts of each turbine is about thirty tons. The two small turbines for the direct-current dynamos have a common supply pipe, two metres (6.5 feet) in diameter, which will be large enough also for the additional 500-horse-power turbine to be installed later.

The speed of all the turbines is automatically regulated by oil from the above mentioned high-pressure oil pumps; the maximum variation of speed between full load and no load is guaranteed not to exceed four per cent.

The two three-phase generators now in use are built by the Elektricitäts-Aktien-Gesellschaft, formerly Schuckert & Company, Nürnberg. They are of the internal revolving field type, the field being mounted horizontally direct on the turbine shaft. Their capacity is 2,500 kilovolt-amperes at 5,000 volts, with a frequency of fifty cycles per second at a speed of 150 revolutions per minute. The revolving field, which has a diameter of five metres (16.4 feet) contains forty poles with bare copper windings. The armature has three slots per phase and per pole. The efficiency is ninety-six per cent.

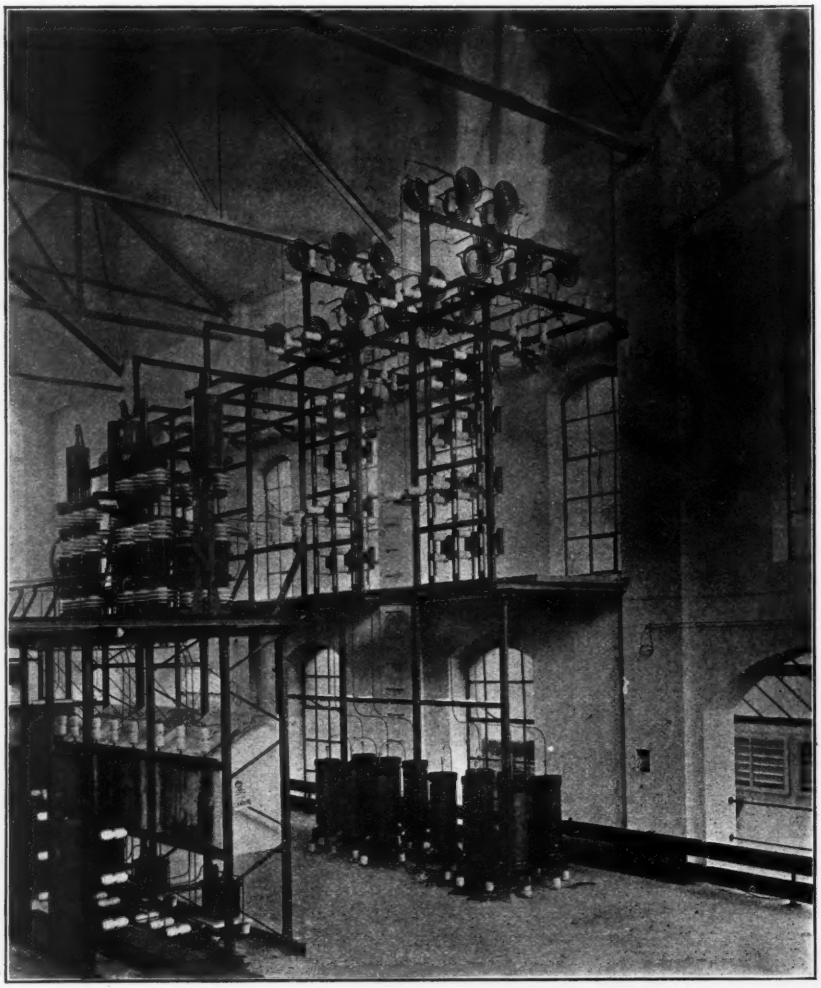
The direct-current dynamos, which serve as exciters, are designed for 115 volts and 1,580 amperes; these are also horizontal machines directly mounted on the turbine shafts.

The present power-house transformer equipment, by which the voltage is raised



View of Machinery and Switchboard, Showing Generators and Exciters.

from 5,000 to 20,000 volts, consists of six units, arranged in two groups of three each. They have a capacity of 950 kilowatts each, and are of the oil-insulated and air-cooled type. Each group has a separate set of bus-bars.



Lightning Arrester Arrangement, Showing Water Resistance on the Floor.

The current from the generators passes through main fuses in the basement to the apparatus room on the first floor, where a switch makes it possible to connect either generator to either set of transformers.

The apparatus room, just behind the generator, is separated from the latter by brick walls and is fireproof throughout.

From the 20,000-volt binding-posts on the transformers the current is led to bus-bars—one set for each group—so arranged that either group separately or both together can be connected to the transmission line.

There are two switchboards; one (for the exciting dynamos) is placed on the floor of the generator room, while the other (for the high-tension distribution) is placed on an operating platform, five metres (16.4 feet) above the floor level.

The shunt regulators for the exciters can be worked together or separately, and the arrangement is such that they can be operated either from the switchboard on the floor or by means of sprockets and chains from the operating platform in front of the high-tension board. On this platform is placed a separate marble desk with volt and ampere-metres, also handles for working the above-named sprocket chains.

On the high-tension switchboard are placed all the necessary apparatus for measuring and controlling the current, phase-indicator handles for oil-break switches, etc. No high-tension current is used on the front of the board.

The metal cases of instruments on the high-tension switchboard, all screens around fuses and switches, and so forth, are solidly grounded to large copper plates buried in the river. This is also the case with the bases of all the machines and transformers, but here the ground wire is provided with a switch which is closed only when the apparatus or machine in question is to be approached or handled. Heavy rubber boots and gloves, also large, wooden pliers are used for the safe handling of fuses.

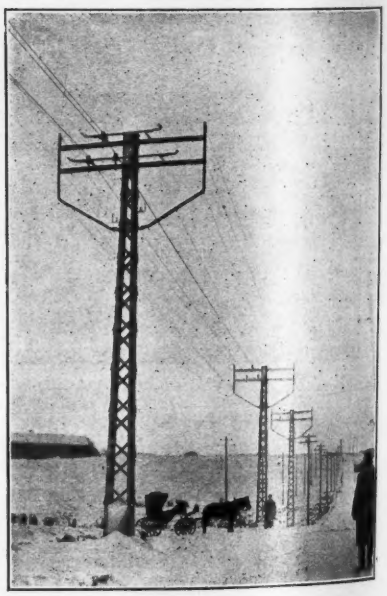
The neutral points of 20,000 as well as 5,000-volt-transformer windings are grounded through switches which are opened when insulation tests are to be made.

The secondaries of all step-down transformers in the station are provided with a device which will automatically ground the circuit when the voltage goes above a fixed maximum—in this case 400 volts. When the device works, an incandescent lamp is lit, indicating on which transformer the trouble is.

Lightning arresters are placed on each line wire just before leaving the power-houses and after entering transformer substations. They consist of cylinders of non-arcing metal arranged in zigzag, and are provided with large choke-coils and water resistances. The arrangement is very clearly shown in the accompanying cut.

The transmission line is about ninety kilometres (about fifty-six miles) long and passes mostly over cultivated land. In the woods trees are cut down to an extent of fifteen to twenty metres (fifty to sixty-five feet) on each side of the poles.

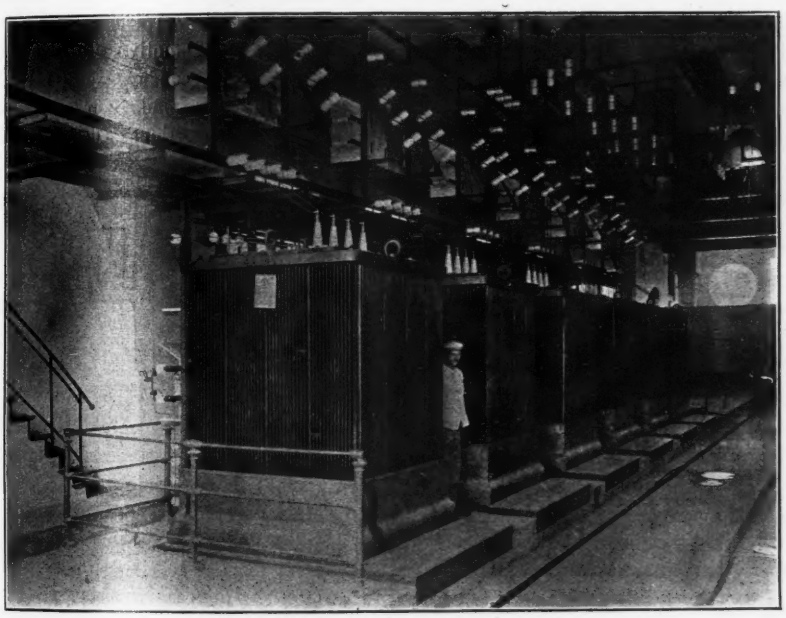
The first part of the line, consisting of three stranded copper cables, each of ten five-square-millimetre strands (equivalent to ten No. 10 B. & S.), crosses the river Glommen not far from the power-house in a span of 128 metres (420 feet) and continues for four-fifths of the total distance to Lysaker substation; from here



A View of the Transmission Line.

a smaller line of three cables, each of seven five-square-millimetre strands, runs to the last substation at Slemmestad Portland cement factory, where motors to a capacity of 500 horse-power have been installed.

The majority of the poles are of pine, mostly 12.5 metres (forty-one feet) high with seven-inch top, but wherever the line makes a bend, however small, and at all railroad crossings iron poles have been used; these are of latticework with square bases set in concrete foundations. Two hundred and fifty-three iron poles are erected—from thirteen to nineteen metres (forty-two to sixty-two feet) high, set as much as three metres (ten feet) in the ground. There are five railroad crossings, at all of which the poles are made so high that a wire in case of a break will clear



STEP-UP TRANSFORMERS.

engines and cars on the rails. When crossing principal roads safety nets are placed under the wires, and, if wooden poles are used, two are erected on each side of the road. When smaller roads or paths are crossed the poles are merely placed so close together and made so high that a wire, if broken, can not be reached by passers-by. Where the line runs alongside a public road grounded guard-irons are placed just below the wires. Crossings with the government telegraph are effected in the same manner as railroad crossings.

The line is supported on triple-petticoat "delta" porcelain insulators mounted on steel pins; the cross-arms are of channel iron fastened to the poles with iron collars; in the middle they are shaped into teeth which are forced into the wood.

On each pole are two cross-arms with places for six wires, two on top, four below; for the present only three wires are run, but provisions have been made for large future extensions, as a double pole line is erected from the power-house to Lysaker substation. The telephone line between power-house and substations is placed on the same poles as the high-tension wires and has given no trouble from induction or other causes.

At full load on the present line the pressure at Lysaker will be 18,000 and at Slemmestad 16,000 volts.

There are no lightning arresters on the line, but at all substations arresters are installed of the same type as at the power-house.

The seven substations now in operation, where the voltage is reduced to 5,000 volts, are handsome brick structures, fireproof throughout, about thirty-five feet long by twenty-eight feet wide, and are each designed to take transformers with a capacity of 1,500 kilowatts. From here the current is distributed, partly on the same poles as the 20,000-volt line, to suitable points where transformers in a ratio 5,000 to 220 are erected, partly in sheet-iron kiosks on the ground, partly on poles. Large motors will be driven directly from the 5,000-volt line without transformers.

The city of Kristiania, the capital of Norway, around which the line is running, has its own large municipal plant and will not allow other concerns to enter its premises. There are, however, negotiations in progress about the city either to buy the whole plant or power at certain places in the suburbs.

A few figures may be of interest: there has been used 130 tons of copper cable for the high-tension lines, ten and one-half tons hard-drawn copper wire for the telephone line, 253 iron poles and 4,452 wooden masts.

Experiments in Wireless Telegraphy.

The London *Electrician* in its issue of September 9 abstracts from a German contemporary the results of a long series of experiments in wireless telegraphy carried out by Dr. A. Slaby. The experiments deal with various important points connected with the tuning of transmitters and afford a test of the value in practice of the formula available for the capacity and self-inductance of wires. The effect of neighboring earthed objects on the capacity of a wire was investigated by measuring by a telephone bridge method the capacity of a wire thirty-three feet long held, horizontally, at varied distances above floors of different kinds. Thus, at a height of one metre above a zinc-covered floor or above a wooden floor, the measured capacity was some twenty per cent greater than the value calculated by the simple formula for straight wires; but with a similar elevation above an asphalt pavement the error was only about six per cent. At heights greater than two metres the ordinary formula is accurate enough, and a modified formula gives values for capacity and wave length agreeing well with all these experiments. The effect of damp weather was noticeable during some of these experiments. It increased the observed wave length somewhat, probably because the capacity of the wire was increased by the presence of water in the dielectric.

To determine whether the electric or magnetic portion of the electromagnetic waves plays the greater part in distance transmission a different set of experiments was made. The apparatus was so arranged that either a potential loop or a current loop transmitter, as desired, could be put nearest the receiving circuit. A difference of about forty per cent in favor of the magnetic effect was observed by Dr. Slaby. However, distances of only three metres were experimented with.

The conclusion is reached that it is most important to give free play to the circles of magnetic force which expand from the current loop at the bottom of the air wire when setting up a wireless telegraph station.

Dr. Slaby investigated the effect of introducing reactance coils upon the rate of rotation from a given air-wire system. The coils were introduced at the lower end of the air wire for tuning purposes, a hot-wire ammeter being used for measuring. It was found that a process of lengthening the wave is accompanied by a diminution in the amount of energy radiated.

OPERATION OF THE SERIES TRANSFORMER.[1]

BY EDWARD L. WILDER.

The field of usefulness of the series transformer is rather narrow as compared with the shunt transformer, and probably for this reason its methods of operation are not so generally understood.

The principal difference between the series and the shunt is, as the name indicates, in the connection in the circuit; the one having its primary in series with the line, while the other has its primary shunted across the line. The primary current, then, in the series transformer, is the quantity which is determined by the condition of the main circuit, the primary electromotive force being merely the drop across the transformer due to its impedence. In the shunt transformer, the primary electromotive force is the quantity which is determined by the main circuit, the primary current being determined by the impedence of the transformer.

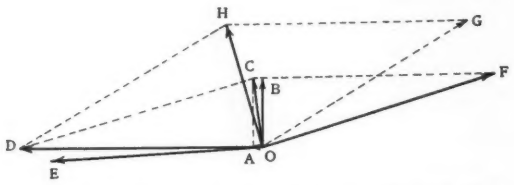


FIG. 1.—TRANSFORMER WITH ONE PRIMARY AND ONE SECONDARY TURN.

Consider the case of the series transformer with its primary coil connected in the line and its secondary coil on open-circuit. The primary current, which is also the line current, will set up a magnetic field in the iron of the transformer, which, by self-induction, will cause a certain drop in voltage across the primary coil. The same magnetic flux will also cut the secondary turns and generate in them an electromotive force whose value is equal to the voltage drop across the primary coil multiplied by the ratio of secondary to primary turns, just as with a shunt transformer. When the secondary coil is open-circuited all of the primary current is effective in producing flux, *i. e.*, there is no opposing flux as there is when there is a secondary current. For this reason the iron of the transformer is worked at a high degree of saturation when the secondary is open-circuited, which gives an abnormally large secondary voltage. In the case of a ten to one-half-ampere series transformer, the test of which is given later, this secondary voltage was approximately 4,000 volts. This clearly brings out the reason why the series transformer should never have its secondary open-circuited when current is flowing in the primary.

Now, suppose the secondary circuit to be closed through some resistance. The primary current and magnetic flux are not changed but a secondary current will begin to flow in such a direction that the magnetic flux set up by it will oppose the primary flux. This will cause a decrease in the resultant flux present in the iron and consequently in the secondary and primary electromotive forces. The secondary current will continue to increase and the secondary electromotive force to decrease until a stable condition is reached where the secondary electromotive force is just great enough to cause the secondary current to continue to flow. This adjustment between secondary current and secondary electromotive force takes place instantaneously. The resistance in the secondary circuit is low under ordinary conditions of working, so that the necessary secondary electromotive force is correspondingly small and the resultant magnetic flux required to generate this electromotive force is small.

If no magnetizing current were required, the secondary ampere-turns would exactly balance the primary ampere-turns and consequently the ratio of the primary to the secondary current would be the inverse ratio of the number of turns. To cause the current to have this ratio as nearly as possible the iron is worked at a low magnetic density so that very little magnetizing force is required. The series transformer is worked at about one-tenth the magnetic density of the shunt transformer, which is the reason why an ordinary shunt transformer would not be suitable for use as a series transformer.

If the line current and, therefore, the primary current increases, the primary ampere-turns are correspondingly increased. This leaves a greater difference between the primary and secondary ampere-turns. This causes a greater magnetic flux, which in turn increases the secondary electromotive force, and as the secondary current increases in response it reacts upon the magnetic circuit to decrease the flux. A stable condition will again be reached when the secondary electromotive force is just sufficient to circulate the secondary current. The ratio between the primary and secondary currents will remain practically the same as before, because of the small extra magnetizing force necessary. There is a greater magnetizing force necessary when the primary current increases on account of the greater secondary electromotive force required by the greater secondary current.

A change in the secondary resistance causes a similar change in conditions; when the secondary resistance is increased this momentarily decreases the secondary current which allows a larger resultant flux, which in turn increases the secondary electromotive force, which increases the secondary current. When a stable condition is reached there is a greater secondary electromotive force and a slightly less secondary current. An increase in the secondary resistance does not mean a proportionate decrease in the secondary current as would be the case in a constant voltage circuit; it means only such a decrease in the current that the resulting increase in magnetic flux and in secondary electromotive force will be great enough to circulate the current through the increased resistance.

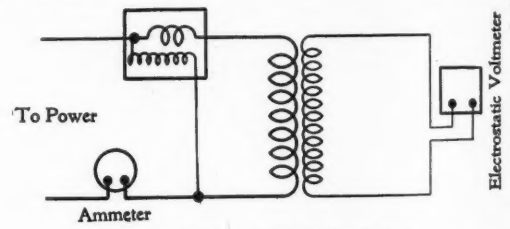


FIG. 2.—DIAGRAM OF CONNECTIONS.

The fact that the current ratio is not appreciably affected by changes, within limits, in the secondary resistance and primary current, is due to two reasons; first, that the magnetization throughout the range of working conditions is small; and, second, that the magnetizing current is not in phase with the primary or the secondary currents, being nearly in quadrature with both. The exact relations of these quantities may best be shown by means of a vector diagram.

In Fig. 1, assume for the sake of simplicity, a transformer with one primary and one secondary turn. Current vectors then will also represent magnetizing force in ampere-turns. The secondary current is supposed to be closed through a low resistance. In Fig. 1 let OD represent a constant primary current. The primary drop will be a little in advance

[1] *Electric Club Journal*, September

of OD and is represented by DE. OF represents the secondary current which is nearly 180 degrees behind OD.

The magnetic force which sets up the flux in the magnetic circuit is the resultant of the primary and secondary ampere-turns, and will, therefore, be represented in the diagram by OC, the resultant of OD and OF.

OC, which is ordinarily called the magnetizing current of the transformer, may be considered as broken up into two components, OA and OB, in phase and in quadrature with the electromotive force respectively. OA represents the current necessary to supply the iron-losses and OB represents the true magnetizing current.

From the figure it is evident that the principal effect of the iron-loss is to change the current ratio, while the principal effect of the true magnetizing current is to shift the phase position of the secondary current.

This furnishes the explanation of the fact that if the primary current is increased or the secondary resistance increased the current ratio is affected. Both of the changes result in an increased secondary electromotive force, which requires a greater flux. This causes a greater iron-loss as well as necessitating a greater magnetizing current, both of which change the current ratio.

As an illustration of the relative magnitudes of the quantities involved in Fig. 1, the results of the test of ten to one-half ampere series transformer are given. The diagram of connections is given in Fig. 2. With the secondary on open-circuit, the primary current and watts were observed for various values of secondary voltage, which were read by means of an electrostatic voltmeter. What was measured, then, was the magnetizing current and its energy component, OC and OA in Fig. 1. The results of the tests are shown in Fig. 3. Assuming full-load current in the primary, the secondary current may be determined for any given secondary resistance by calculating what secondary voltage is necessary to give one-half an ampere with this resistance, finding the corresponding magnetizing current, and making a construction similar to Fig. 1. The primary voltage and current may be considered to be in phase as they differ in this case by only a fraction of one degree. If in any case the secondary current differs much from the assumed value of one-half ampere, the secondary voltage may be corrected accordingly and another construction made.

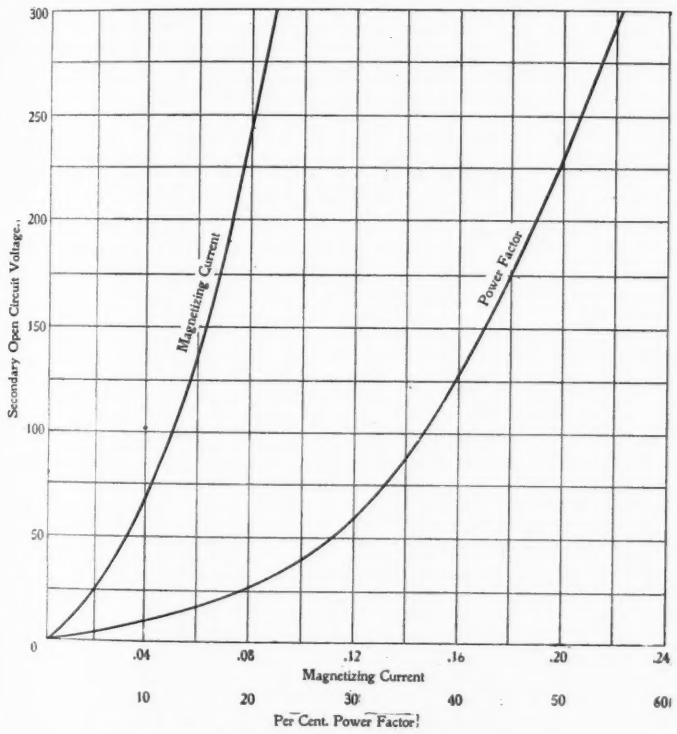


FIG. 3.—RESULTS OF TESTS ON LINE TRANSFORMER.

The following table was calculated in the manner indicated.

Ten to one-half ampere series transformer, sixty cycles.

Secondary internal resistance 100 ohms.

Secondary External Resistance in Ohms.	Primary Current Amperes.	Secondary Current Amperes.
0	10	.498
100	10	.489
200	10	.480
300	10	.474
400	10	.467
500	10	.461

This transformer was designed for a variable high secondary resistance, the maximum resistance being 400 ohms. This is an unusually severe condition to meet, series transformers ordinarily working with about ten ohms secondary resistance.

New Form of Trolley for Multiple-Unit Trains.

The Key route which has recently completed a ferry and train service connecting San Francisco, Cal., with cities across the bay was obliged, says the *Scientific American,* to devise a new form of current gatherer. The lines, running almost exclusively on the public streets, made the third rail out of the question, while the weight of the trains and great speed made the gathering of current by the usual trolley-wheel impracticable. Eight-car trains, weighing approximately 350 tons, are operated at speeds as high as fifty miles and greater, which requires, approximately, 2,500 to 3,000 amperes. A gathering device was required which would meet these conditions and operate at high speed on curves. In addition, it must have a range of not less than six feet in height for passing through subways and over surface crossings. The device which has been in use for over a year has met these conditions very successfully. It has done away with all trolley frogs and switches, except at right-angle crossings. The trolley consists of a double diamond frame of angle iron made of four conjoined frames connected on each side by elongated joints to give stiffness. At the top and bottom the frames terminate in segmental gears. The gears at the bottom cause the side frames to move in unison, while those at the top keep the guards always in a vertical position. A roller is carried at the top of the shaft, the ends of which are fastened rigidly in a casting to which the guards are secured and on which the segmental gears pivot. This roller is made of twenty-four by five-inch non-arcing metal tubing with hubs at each end having graphite bushings which form the bearings. The guards, which are necessary at branch-off wires, are made of pressed sheet steel. The tension springs are in practically the same plane as one side of the bottom frame. This arrangement gives practically a uniform upward pressure on the roller for all positions of the trolley wire. Among the engineering difficulties that were overcome in the construction of this new line, was passing under the main tracks of the Southern Pacific Railroad Company. A tunnel was built, the opening of which is on a long mole some distance below the point of low tide.

TELEPHONE ENGINEERING—XI.

BY J. C. KELSEY.

THE ORIGINAL FORTY-VOLT SYSTEM.

A general study of the Stromberg-Carlson system reveals four general and distinct stages not revolutionary in character, but showing a distinct gain in advantage from several standpoints.

The first stage shows a forty-volt battery, not grounded on one side, as is the usual practice, a single disconnect or supervisory lamp signal, a complicated, yet very effective line jack, and a characteristic use of the bridged primary and transmitter, rather than the usual bridged secondary.

Owing to the uncertainty of the rights of the multiple jack system, the first systems had to have characteristics which would fulfil the functions of multiples without infringing on the original claims of the multiple patents. This jack, which appears at first sight to be a complicated affair, is composed of three movable springs, one immovable spring and the sleeve, or thimbles. It is not only a multiple jack as far the subscriber is concerned, but is a series jack as far as the line signal is concerned. It has none of the objectionable disadvantages of the conventional series jack, because the subscriber's instrument has no series contacts in the circuit. Whether the series contacts are open or not, the parties can be called without chance of open jack circuit. Truly an ingenious solution.

The subscriber's instrument is of the well-known independent type, in which the transmitter and primary winding are in the battery circuit when the receiver is removed from the hook switch. The secondary winding and receiver are in a closed circuit, while the condenser and bell are only in circuit while the receiver is on the hook.

The removal of the receiver (Fig. 15.) closes the subscriber's circuit, and the current may be said to flow from the negative side through the magnetic signal LMS, to the contact C2, thence to movable spring R4, thence to immovable spring contact C1, to movable spring R2 to contact *c*, thence movable spring R, thence out on the line side 1, through transmitter, primary winding, hook contact, line side 2, directly back to positive battery through the retardation coil RET. Between RET and the line are seen jack springs, letter T, in multiple throughout the length of the board. Current flowing causes the magnetic signal to be energized, and it shows itself to the operator in the usual fashion of changing color or making a slight metallic noise. The operator inserts the plug, which causes, let us say, jack No. 2 to have its springs R3 and R4 spread apart. R4 is then separated from immovable spring at C2, which opens the circuit of the magnetic line signal MLS, which is restored to its normal condition. But the cutting off of battery must be of short duration, and the shorter the better, for the subscriber receives a vicious click in his receiver at the instant of opening the circuit from the stored up energy in the induction coil.

One of the pleasant features of this system was the freedom from this vicious receiver click. At no time was the circuit open from the subscriber's standpoint. The plug contact, which served to operate the springs, also carried the battery which

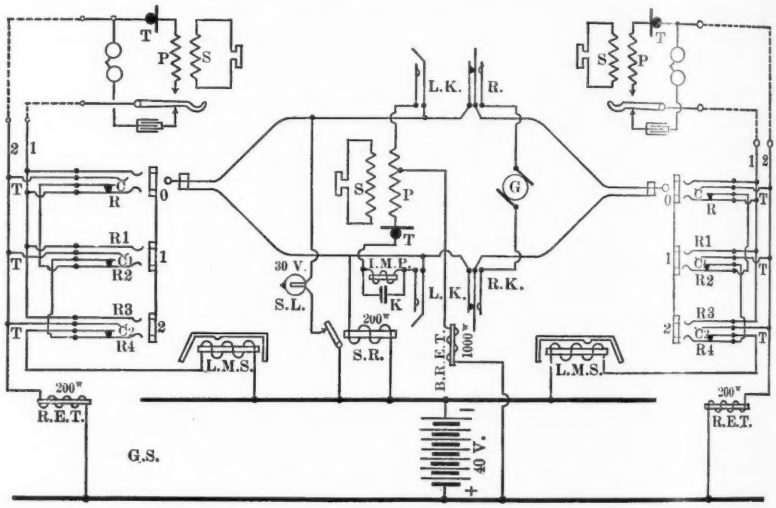


FIG. 15.—SINGLE DISCONNECT SYSTEM.

was to replace the battery cutoff. There is a change in the electrical condition of the circuit, simply a temporary increase of battery current, which did not cause the least objectionable receiver click. The decrease in the amount of current in the circuit coming from the removal of the path through signal MLS also did not give any objectionable click. The circuit was made before it was broken, and on one side of the circuit only.

The entrance of the plug creates a new circuit, and battery flows to the subscriber through SR, the supervisory cord relay, jack contacts R3 and R4, over line side 1, through instrument and back to battery over the unchanged circuit of RET, the tip side of the circuit. Here is a characteristic feature throughout the company practice, the absolutely permanent usage of one side of the line circuit. The circuit is balanced, for the 200-ohm cord relay SR balances the retardation resistance RET, which is 200 ohms. Both having the same magnetic properties, the circuit is balanced to all alternating fluctuations and is individualized from the other circuits.

The removal of the receiver and the flow of current through relay SR causes it to be energized, the lower back contact open, the lamp SL darkened. The operator throws listening key LK, which bridges the transmitter and primary winding across the talking circuit. To prevent the low resistance primary winding, and non-inductive transmitter resistance from seriously cutting down the transmission, an impedance coil is placed in series with the apparatus. To prevent the impedance IMP from exercising its usual function of distorting voice currents, it is bridged by a condenser, K.

Receiving the number, the operator tests in the usual manner. If the line is busy, a potential exists on all the sleeves, or test terminals, exactly that which exists on the sleeves of the plugs, which we may say, is negative potential. As the tip is given a positive potential in the act of testing, a current will flow in the operator telephone set, when the tip of the calling plug is touched to the sleeve of the busy line jack. To give the plug tip a potential of positive value, when it has a natural negative potential, resort had to be taken, in which the primary winding was opened about one-third of its length, and a terminal pulled out, which is attached to the positive side of the battery. Therefore, when the listening key is thrown on to a line, the positive terminal of the battery is connected to the tip of the plug in such a way through the primary winding as to not interfere with its successful operation, and a successful test click is given.

In two-strand practice, for this system

really comes under that head, the touching of a cord tip to a jack has to be particularly safeguarded to prevent the parties talking from being seriously interfered with, while the test is made on their lines. The touching of the tip in the case at hand, connected as it is to the positive side of the battery, through a small portion of the primary winding, it is plain to see that the battery potential at the subscriber's jack would be seriously lowered in the act of a test, and the talking subscriber given a savage receiver click. To avoid this, a retardation, BRET, is placed in the circuit connecting the positive and the split portion of the primary. Being of 1,000 ohms, a great number of turns, and highly inductive, it would prevent a sudden change of potential at the subscriber's jack, and the test could be made without objection. Finding the line idle, the operator inserts the calling plug, and rings on the line by means of key RK. When the party answers, the operator has no means of knowing it, because the calling subscriber has controlled the relay SR. If either subscriber should hang up receiver, the signal would not be affected, because both subscribers have to hang up, before the operator sees the disconnect signal. When both parties hang up their receivers the cord supervisory relay SR becomes deenergized, and its back contacts close the circuit of lamp SL. The circuit of lamp SL has two paths. One is through the tip of the answering plug, tip of the jack, and thence back to positive battery through the coil RET, of 200 ohms resistance. The other path is through the tip of the calling plug, tip of jack concerned, and through the 200-ohm coil, RET, to positive battery of the line concerned. These paths are in parallel, which puts one hundred ohms in series with the thirty-volt lamp of the cord circuit, which, with forty volts, causes it to light to its full brightness. The entrance of either plug will cause lamp SL to light, but not to its full brightness. There is no use of its doing so, because it is only supposed to give a disconnect signal when two parties have completed conversation.

The great growth of telephone interests made a single disconnect switching system a hopeless proposition. And the great size of the switchboards made the complicated jack, with its many springs, an adverse factor. To eliminate the series cutoff jack requires the use of an electrically operated cutoff relay. This

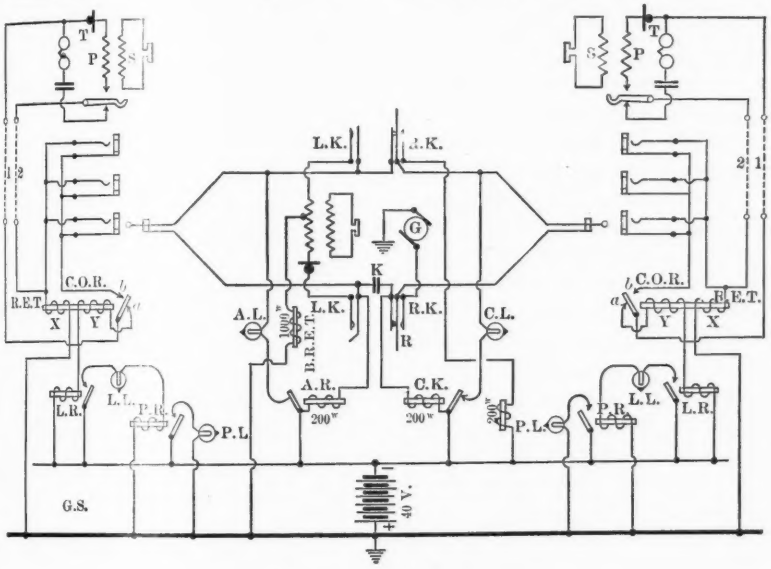


FIG. 16.—DOUBLE DISCONNECT SYSTEM.

feature of the second stage adopted, besides the elimination of the many pointed jack, and the magnetic signal. Two lamp signals operated in connection with the cord circuit, and a line relay caused a line lamp to be lighted, instead of the cumbersome magnetic signal to be operated. A simple two-strand jack made its appearance, and is now a standard style.

The general form of the second stage is shown in Fig. 16. The subscriber's station is not changed, and the removal of the receiver operates the line relay LR and causes it to light the lamp LL, which in turn, causes the pilot relay and lamp to operate PR and PL and to cause the night-bell relay NBR to close the night-bell circuit. The current that energizes the line relay LR, also flows through the cutoff relay COR. But the current does not actuate COR, because it flows through the separate coils of COR in opposite direction. Then the relay COR may be called a differential relay, and will only operate when there is a difference of current strength in each of the coils which are wound in tandem on the core of the coil. Being tandem wound, and if wound of the same resistance, there would be a difference in the magnetic effects, and relay COR would not fulfil its proper function. To cause the coil nearest the armature to have the same effect as the coil on the opposite end, the coils are wound with 190 ohms of wire, possibly 200 ohms, on the end near the armature, and with 210 ohms on the end farthest away. Therefore, the current that energizes relay LR flows from negative battery through LR, winding Y of COR, contact *a* of the armature of COR, line side 1, through instrument, line side 2, through winding X, thence back to positive battery or ground. Winding X or RET acts as RET in Fig. 15 in many ways.

The operator sees lamp LL lighted and inserts the plug, which causes the lamp LR to become darkened. This lamp is darkened, because the entrance of the plug actuates COR and breaks the line circuit at contact *a* on COR. COR operates, because the entrance of the plug has given a new circuit for current to flow, which strengthens winding X and weakens winding Y. That new circuit is lamp AL. But since the subscriber's telephone is off the hook, then relay AR, which takes the place of relay LR, is actuated. The actuation of relay AR opens the lamp circuit of AL and the unbalancing effect upon COR is apparently but temporary. But the effect lasts long enough to close the contact *b* of COR and winding X becomes a permanent part of the circuit, which includes relay AR, sleeve of plug and jack, line side 1, instrument, line side 2, winding X or RET. Only the instants use of lamp AL is necessary to pull up the relay COR. If relay armature is once pulled up, it will stay up as long as the plug is in, regardless of subscriber. If the subscriber hangs up, then relay AR lets loose and lamp AL furnishes the unbalancing effects. The operator's set is shown as in the former figure and the busy testing device shown to be the same. When the operator finds a line idle, she inserts the plug, and rings the subscriber's bell by means of key RK. The generator is shown as G in drawing and comes into contact with the sleeve spring of the ringing RK when cam is thrown. The generator current passes out on the line through sleeve spring R, through the instrument and back to the generator ground through the 100-ohm resistance M and battery. This battery and resistance

serve to hold the cutoff relay in operation during the act of ringing. The lamp CL could serve the same purpose and possibly does so in many cases.

The entrance of the calling plug lights lamp CL and operates the cutoff relay COR at the same time, thus preventing the lighting of the subscriber's line lamp when he answers. When he answers the relay CR is energized and lifts its armature from a back contact and darkens lamp CL. When both parties hang up, the lamps AL and CL light up brightly. If one party hangs up, the lamp corresponding lights brightly. Unlike other systems so far, the act of plugging in with one plug will light both lamps, not brightly, because they shunt one another.

The main feature of this stage is the two-strand jack and the differential relay. There is a question of the balance of two circuits connected together, as the cord circuit puts a condenser about the relays AL and CL and puts a short-circuit across the X windings, thus throwing them together, giving the tip side of the circuit 100 ohms on one side, while the sleeve sides each have 200 ohms. But the smooth working of these systems, in districts where the greatest difficulties beset telephone operating, go to show that there is balance enough for the greatest of practical purposes.

The operation of the differential cutoff relay seems hard to understand, but when one studies closely, it is easy to see that when the subscriber's telephone is on the hook that the lamp AR, for instance, will cause current to flow in X that won't flow in Y. When the telephone is off the hook, then is relay COR locked by current through AR, instrument and winding X.

International Wireless Telegraph Conference Postponed.

The international wireless telegraph conference, summoned at the initiative of Germany, and which was to have met on October 4, has been postponed at the request of delegations from France and Great Britain. These countries desire more time to study the questions involved. The United States government will be notified when the date for the meeting of the conference has been determined upon. This conference was to have been held in Berlin, Germany.

Wireless Telegraphy in Siberia.

A wireless system has been started across Lake Baïkal between the stations of Baïkal and Tankha. The Slaby-Arco-Braun system is used. The expense of construction will be met by the railroad at Zabaïkal and Krougobaïkal.

AMERICAN PRACTICE IN HIGH-TENSION LINE CONSTRUCTION AND OPERATION.[1]

BY DR. F. A. C. PERRINE.[2]

A characteristic of American practice is that it tends toward standards not only in the matter of the sizes of units, speeds and manufacture appearance, but also in the methods of producing results and in types of engineering. While it may be true that this tendency was originally based upon a desire for cheap manufacture and interchangeability of parts, at the same time it must be understood that the present elaboration of this policy is somewhat due to the fact that in so large a country the ideas of the best men can not be directly applied except as they may be adopted for standards. No one section of the country produces the best men necessarily, nor does any one group of engineers dominate our practice. On the contrary, the meetings of our engineering societies have taken the character of sittings of committees, where are presented many plans, and where all plans are carefully discussed and sifted. From those presented the best is chosen and becomes the standard.

Accepting these results as the standard does not imply that there is general in this country a spirit of copying or of servile imitation among the engineers. On the contrary, we feel that the result of the attitude so prevalent in American engineering at the present time, of establishing standards, has introduced a wise spirit of conservatism, and has thrown the burden of proof upon each one presenting a new idea. At the same time it has resulted in raising the character of the average engineering work throughout the country, until to-day good American engineering can be found, not only in the great spectacular plants near enough to the large centres of progress to have the personal attention of the most experienced engineers, but in consequence of this system of practice an equally good type of engineering can be found in the plants in the out-of-the-way deserts or mountain regions, where the local engineer of good capacity, knowing his conditions thoroughly, has relied upon the standards established by his fellows in those particulars where his own experience has been limited, and in consequence a plant is produced, not only more perfectly adapted to the particular circumstances of its surroundings, but in all details more thoroughly satisfactory than could have been designed under any other system. Our rule is that invariably one should adhere to well-established practice and introduce such modifications as are made necessary by the local conditions. This does not limit the full employment of the energies and brains of the local engineer, since, without a special consideration of outside details, there are always in every transmission plant particular circumstances which tax the ingenuity of the best. That this is the general method of American practice will be seen by any one who consults the report of the standardizing committee of the American Institute of Electrical Engineers. The report covers, not only units, standard methods of testing, and details of manufacture, but also procedure, both outdoor and in, for all types of plants, and this report in itself has resulted in a certain similarity of type where problems to be solved are similar.

The work of the transmission engineer lies in fields so essentially dissimilar that even in spite of this general tendency it may be difficult at first view to ascertain what is the American practice in work of this class. On closer examination one finds, however, this work falling into natural groups dependent on the length of transmission and the voltage employed, though what has been done has been materially modified by the date of erection, since during the past ten years modifications in the arts have been necessarily reflected in the types of construction.

The general groups have been somewhat decided by the manufacturers of machinery, who have presented as preferable certain available voltages. Above 2,400 volts, where transmission proper really begins, the first voltage now commonly employed is 6,600, which figure has been established as standard by the needs of the lighting plants in the great cities, and has been adopted by the transmission companies in place of either a higher or lower voltage mainly because it is a standard. For this voltage direct generation at high pressure is almost invariably used. The next higher voltage now commonly employed, and practically the first one for which step-up transformers are used, is 15,000. During the past few years this has taken the place of transmissions at 10,000, 12,000 and 13,000, and it is to-day the established voltage for high-tension electric railways, the general reason for its establishment as a standard being that this voltage is not more difficult to handle, as regards insulation or switching, than the three last-mentioned lower volt-

[1] Presented before section D—electric power transmission—at the International Electrical Congress, St. Louis, 1904.

[2] Delegate of the National Electric Light Association and of the Pacific Coast Transmission Association.

ages, and, furthermore, that, where the lower voltages have been previously established, the sphere of operation of the transmission plant has been found to be rather too much limited. There are in the Rocky mountain region and west a great number of the older plants operating at 10,000 volts, and whenever direct high-voltage generation has been attempted, voltages of from 12,000 to 13,000 volts are used; but, at the same time, the majority of the plants which have used the lower pressures in the past to-day have circuits with special transformers operating at the higher figure. The next step is to 25,000 volts, which is the highest figure reached without special study of insulators, switches and lightning arresters. This voltage has been successfully handled without serious trouble during the past six years. A voltage of 35,000 is employed in a number of plants built about five years ago, and at this figure the special difficulties due to line capacity, insulator size, erratic lightning-arrester effects and switching begin to make themselves seriously felt. Above 33,000 volts the standard voltage is called 60,000, although in all plants that have heretofore been established to operate at this pressure, there have been installed transformers arranged for connection to various voltages of from 40,000 up to 60,000 volts, and the majority of these plants are to-day operating at about 50,000 volts, some of them being unable to operate at the highest pressure on account of the character of line insulators originally installed. In the choice of voltage for any transmission it is considered the best practice to establish it at the rate of 1,000 volts per mile, provided the length of transmission be not above sixty miles, since above 60,000 volts no commercial work has been regularly attempted. In the table recently presented by the transmission committee of the American Institute of Electrical Engineers, the highest average voltage per mile for any one class in their report is 840; but in examining this table it must be remembered that their correspondents have reported the total length of line in service, so that, if a plant operated two lines fifteen miles each in length at 1,500 volts, their table would indicate an operation of 500 volts per mile, although for each line the transmission was at 1,000 volts per mile.

In the generation of power the revolving-armature machine has almost disappeared from the new plants, and revolving field generators have become so settled in type that those produced by different manufacturers are hardly distinguishable by the casual observer. For the low-head plants using turbine wheels it is necessary to provide for a fifty per cent increase of speed, and in the high-head plants, where impulse wheels are employed, a strength sufficient to withstand a speed increase of 100 per cent must be allowed to provide against damage from overspeeding should the power be thrown off and the water continue to flow. The machine fulfilling these conditions and practically adopted by all the manufacturers is characteristically a revolving field machine with the poles keyed to a cast-steel spider, the field windings being of copper strip wound upon edge, the armature being constructed of a cast-iron box girder supporting the stationary armature laminations. Almost the only departure from this type of construction for power-transmission work is found in the balanced type of inductor machine, where the field is magnetized by a central stationary field coil wound with copper strip, the armature in two halves symmetrically arranged around the central core being of laminations supported either by cast-iron rings connected together by cold-rolled steel bars or supported by a steel shell to which the armature laminations are keyed.

Various station voltages have been employed, but, where direct generation at 6,600 or 12,000 volts has not been resorted to, the practice is setting more and more to the use of about 2,300 volts, this being chosen because the lower voltages require large extra station copper and the higher voltages are felt to introduce unnecessary station difficulties of insulation and switching. For switching, the present type of 2300-volt oil switch has been so well developed, by reason of the great number of plants operating at this pressure, that for handling a particular amount of energy it is both cheaper and better than any 500-volt switch on the market.

For plants operating at less than 25,000 volts, the step-up transformers in use are about equally divided between the water-cooled, oil-filled types and air-blast types. Where a good supply of water is to be readily obtained, the oil-filled transformers have generally been given preference, as they can be more readily adjusted for a varying flow of water at different loads. The question of the relative fire risk from the two types has been extensively discussed, and it can hardly be said that any very definite conclusion has been finally reached, though the weight of opinion seems by far to be that the fire risk is at least not increased by the use of the oil-filled transformer, and the actual risk in either type seems to be a matter largely of installation. It is perfectly true that there have been some very serious fires, resulting in the complete destruction of power plants, where oil-filled transformers have been used, but in each case the fire has started outside of the transformers, though they themselves, by reason of being installed without reference to safety in case of fire, have furnished fuel which has augmented the conflagration. To-day the conditions of installation for safety are better understood, and it now only remains to be decided whether, in the case of a fire actually arising, the oil shall be run out and the transformer cases filled with water, or the whole transformer protected either by running in an excessive amount of water through their cooling coils or by so installing them that the transformers may temporarily be submerged to within a few inches of their tops. Actual protection of transformers by running water through their cooling coils has been found to be effective in at least one serious fire.

For high-tension switching, use has been made of a long arc-breaker between carbon terminals and long-enclosed fuse—a fuse drawn through a tube filled with a fine, non-conducting powder—and of oil switches. The first two types, while interrupting the circuit well, draw an arc of excessive length and produce a surging which may result in an increased potential of at least as much as fifty per cent. In consequence, these types are rapidly disappearing except, in plants operating at 15,000 volts and below, where the carbon break is preferred to the enclosed fuse, though it is common to install the two in series, allowing the fuse to operate as a safety device, but not for the purpose of switching. The type of fuse where wire is drawn through a tube filled with powder was found to operate successfully up to 40,000 volts and without serious surging on the circuit, but the powder being blown out with great force, and scattered over the entire station, is in consequence not allowable. The oil switches mainly employed are those with the vertical break and those with the horizontal break. The vertical-break switch has the advantage that the amount of oil contained in the oil-tank is relatively small, and will add to possible conflagration only a slight amount of fuel. This switch is often found on severe short-circuits to blow all the oil out of the tank unless the tank is built very strongly, when it becomes necessary to insulate the plunger from the tank as it enters the switch.

The horizontal-break switch, while containing a large amount of oil, will for the same length of break handle about twenty-five per cent more energy at any definite potential. This switch can successfully be used at 60,000 volts, and up to the present time has not been found to blow the oil from the tank. The two types of oil-switch are the standard to-day, no distinct preference being given to the horizontal switch, though the writer believes that in the future this type will be used as a standard for the highest potentials.

Transmission with two-phase connection of circuits, whether using three or four wires, has for voltages above 6,600 given place entirely to transmission with a three-phase connection, though three-phase transmission with two-phase distribution described by Mr. Scott at the International Congress of 1893 is very extensively employed.

The relative merits of the delta and star connection of the lines to the transformers is still somewhat in dispute, so much so that in plants of the highest voltage, where several voltages are provided, certain of the lower voltages are obtained by delta connections to the transformers, while the higher voltages are to be obtained by a star connection. In general it may be stated that up to 25,000 volts the delta connection is generally preferred, principally because with this connection a ground upon one line does not necessarily result in a short-circuit, and, furthermore, the service is not necessarily interrupted in the case of the failure of a single transformer. At voltages higher than 25,000 volts the transformers for delta connection become more difficult to build and insulate. Furthermore, a single ground anywhere produces disturbances of a serious character, and in consequence the star connection with the grounded neutral is employed, advantage being taken of the fact that a grounded neutral aids in the distribution of unbalanced loads, and furthermore, the rise of pressure which may occur from line discharge at the time of an open-circuit or a short-circuit is not so likely to produce serious results.

For the distribution of current through the low-tension mains, it is generally the custom to transform to 2,300 volts, two-phase unless either the load is mainly one of motors, or unless there are important motors of considerable size to be supplied at a distance of half a mile or more from the substation. In such cases three-phase star-connected four-wire distribution is employed, allowing the connection of distributing devices either to a 2,300-volt circuit between lines and the neutral wire, or a connection to a 4,000-volt delta circuit for balanced loads. This combination of circuits is found to be extremely useful where a mixed load is to be supplied at varying distances.

The high-tension lines themselves are preferably run over private right of way. Railroad rights of way were at first highly prized on account of the entire absence of trees and disturbing structures, and furthermore, on account of the fact that inspection and repairs are most easily provided for; but experience with such lines has proven that, for transmissions at even so low a tension as 15,000 volts, the interference with insulation by the smoke from the locomotives, which covers the insulators, more than counterbalances all the advantages, and to-day such rights of way are more commonly shunned than sought. Where railroad locomotive smoke combined with sea fog is encountered, it becomes absolutely necessary to clean each insulator at frequent periods, even though the voltage of transmission be not more than 5,000 or 10,000. Along the country road this difficulty is not apparent, but in some localities farm structures and trees interfere with the transmission, so that in general it may be said that a private right of way that the transmission company can absolutely control is much to be preferred.

In the most recent types of construction the height of pole is limited as much as possible. Where there may be some increased security from malicious disturbance in the use of high poles and decrease of line capacity may be expected, these advantages are only obtained at the expense of stability and at an increased cost. A pole thirty-five feet high set five feet in the ground permits the safe installation of either a single three-phase line with a spread of as much as six feet by supporting one insulator on the top of the pole and the other two on the ends of a long cross-arm; or it may be used to support two three-phase circuits on opposite sides of the pole with a spread between wires of three feet by the use of two cross-arms, and at the same time such a pole permits the safe installation of telephone or other signaling circuits on brackets or cross-arms at a safe distance below the power lines. These poles should not be less than eight inches in diameter at the top and not less than twelve inches in diameter at the ground line. Variations from these dimensions may be considered as being due to special considerations based upon the location of the lines or arrangement of the circuits. It is true that such a standard pole may only be arrived at after a consideration of the wind stresses on the particular lines taken in conjunction with the spacing of the poles, but as the maximum pole spacing on transmission lines is about 130 feet and at average wind velocities the pole dimensions may be considered safe. Extra strength required by variations of wind stress, either due to an increase in the number of wires or to a necessity for allowance for sleet, is more commonly taken care of by shortening the span than by an increase in the size of the pole. In some cases where severe sleet conditions are to be encountered and the wires changed, it is the practice to install these poles at not more than fifty feet apart.

The material used for poles depends largely on the locality. In the southeastern states chestnut is the favorite wood; along the Canadian border and through the Rocky mountain regions cedar is employed, while square-sawn redwood is used almost exclusively on the Pacific coast. With increase in voltages and consequent increased trouble from insulators, a demand has arisen for a pole-line construction which will permit a decrease in the number of insulators and allow an increase in the size of each. This has been accomplished by the use of galvanized-iron towers not less than forty feet from the ground line to the wires, and spaced about 500 feet apart. One plant in Mexico has recently successfully installed this method of construction. A second in the same country has contracted for its material and a number of plants in the United States are contemplating its use. The question of the life of wooden poles depends not only upon the character of the wood and its condition when cut, but also upon the local conditions of atmosphere and soil. In some places the poles which are available have no longer life than about five years, and, in the extreme, wooden poles can not be greatly depended upon for a period greater than fifteen years, though the redwood poles installed along the lines of the transcontinental railroads west of the Rocky mountains have in many instances given a life up to thirty-five years and are still found to be in good condition; but these poles are set into a soil strongly impregnated with alkali in a country where rains are few and the air generally dry. Nothing is known as yet of the life of the galvanized-iron towers except from the windmill practice, where towers which have been galvanized after all punching and machining is

done are found to be in good condition after a period of ten to fifteen years.

The cross-arms in use are almost invariably made of pine without treatment other than painting. These arms are let into the pole from one to two inches, being held by bolts through the pole and arm, and when long are additionally supported by braces. Even with higher poles wood arms are used, the general feeling being that there is less probability of the circuit being completely disabled should an insulator break and the line fall, if it falls upon a wooden rather than a steel arm. At the same time an experiment in the use of wooden braces has not been found to result in any advantage. In consequence flat galvanized-iron braces established a number of years ago as standard by the telegraph and telephone companies are now almost universally employed in the construction of transmission lines. With increase in spans and voltages the insulators are increasing in size. This condition will probably in the future demand a strength of arm greater than can be obtained by the use of wood. This problem, however, has not as yet obtained a definite solution.

For plants operating below 25,000 volts much use has been made of glass as a material for insulators. Glass has been for many years the standard insulator material in American telegraph and telephone practice, and in spite of many experiments that have been tried with porcelain, it is still considered the best and cheapest material for this service. However, in transmission work one of the great advantages claimed for glass in telephone and telegraph practice disappears. The engineers of these companies claim that it is important to provide against dark, narrow spaces within the insulators on account of the fact that they form the homes of insects. The transparency of the glass largely obviates this difficulty. Where large insulators are used such as are employed by transmission companies, the spaces within the insulators are well lighted from below, and the transparency of the material is not important. Glass is comparatively fragile, and for transmission work it has nothing to recommend it except low first cost and cheap inspection; these, to be sure, are very often overpowering advantages when the voltage is low enough, so that the particular form of insulator used gives a large factor of safety, and in consequence up to 15,000 volts glass insulators are generally preferred unless there are special climatic conditions which render them liable to fracture. Many series of tests have shown conclusively that the porcelain insulator has a greater mechanical strength, is less liable to surface leakage, has a safe dielectric strength, and in addition that it is exceedingly difficult to so break the head of a porcelain insulator as to allow the wire to fall away from it. The one disadvantage of porcelain is that there is an uncertainty as to its solidity, and that it is only possible to ascertain its solidity by most careful high-voltage tests. The question of the form of high-voltage insulator as yet is in high dispute, operating engineers being inclined to a design where the petticoats are very long and comparatively close together, so that great creeping distance be given over the surface of the insulator between line and line and between line and pin, comparatively little regard being placed on the flashing distance. Engineers of the manufacturing companies, however, incline toward one of a much more open type of large diameter and with few petticoats. This latter form undoubtedly gives the greatest sparking distance, has the least dark spaces within it, and is more readily cleaned by rain storms. It is also important that such an insulator be constructed to operate at high voltage without noise, and, as there is a definite loss of energy whenever the insulators on a line are noisy, it may be safely predicted that the open type of insulator is to be the one that will be in the future considered as the standard.

While insulator size may be largely determined by form, at the same time we may in general note that up to 10,000 volts, insulators, whether of glass or porcelain, have a minimum diameter of about five inches. A seven-inch insulator can successfully be used on voltages as high as 25,000, a thirteen-inch insulator is sufficient up to 40,000 volts, while at 60,000 volts it does not seem safe to install insulators having less diameter at the top than fourteen inches. A greater size would unquestionably invariably be used for these high voltages if the problems of the manufacture of porcelain and support of the insulator were altogether solved.

For support of insulators on cross-arms it is necessary to provide that the lowest petticoat be raised above the cross-arm as much as the radius of the insulator, and, as the strain comes on the extreme top of the pin, it is obviously difficult to successfully support the largest size of insulators by means of the common pin in cross-arm construction. By using carefully selected woods, this has been successfully accomplished for insulators up to eleven inches in diameter, but at 40,000 volts in bad weather such insulators carry enough current over the city to char a wooden pin. Accordingly practice has settled to the use of iron pins in plants operating above 25,000 volts. At this voltage and below the wooden pin can be successfully used and indeed forms a certain protection to the line by reason of the fact that the pin itself is a safe insulator, and is only in danger of being burned where the insulator is punctured. Above this voltage, however, only metal pins can be employed, not only on account of the large size of the insulator, but also on account of the fact that there is much burning of wooden pins. The manner in which these pins are burned has attracted considerable attention, having presented some problems which are exceedingly interesting. There is no doubt but that the effect is due to leakage over the surface of the insulator, but it is extremely interesting to note that in some cases the pin is actually charred, whereas in other cases there is an apparent disassociation of something in the wood, and peculiar salts are left behind either reduced from the atmosphere or from the material of the wood itself. This matter was discussed by Mr. C. C. Chesney in a paper read before the American Institute of Electrical Engineers.

The materials that may be used for pins are locust and eucalyptus. The latter wood is decidedly preferred in the plants west of the Rocky Mountain region and where it is readily available, as the wood has been found to be as strong as hickory, dense, and readily handled when thoroughly seasoned and dried. For the largest sized pins, however, as has already been said, no wood is entirely satisfactory, and in consequence use is made of malleable cast iron or cast steel.

As regards conducting material, it may, of course, be said that the only materials at present available are copper and aluminum. For a number of years there has been a discussion of the possible use of iron for short lines on high-potential plants, since the smallest copper wire that may successfully be strung is unnecessarily large under such circumstances. This procedure, however, has not obtained the approval of any of our electrical engineers. The copper wire is invariably uninsulated in high-tension work, since it is correctly believed that no insulation is a true protection, and the frank nakedness of the bare wire is a warning, and in consequence a safeguard to those who are compelled to work near the line.

Copper is used either soft, hard-drawn or stranded. For transmission work,

where the wires are smaller than three-tenths inch in diameter, use is not made of soft-drawn wire, and it may be stated that the standard in American practice is to use soft-drawn wire only for large, low-potential circuits where the small change in conductivity due to the hard drawing is an important factor. Up to three-tenths inch hard-drawn copper may be considered standard. Between three-tenths and four-tenths-inch diameter the practice is evenly divided between solid hard-drawn wire and strand. Larger than four-tenths-inch strand is almost invariably employed. Some use has been made of solid aluminum, but, as the material must be handled with great care, it has been found generally to be the better practice to employ aluminum strand, which is more readily installed and more reliable after installed.

Preference between aluminum and copper is almost entirely a matter of price for transmission lines. It is true that aluminum is stronger in reference to its weight for different conductivities than copper, but at the same time it is materially larger, and the resultant transverse wind stress on the line greater. For short lines, delivering a small amount of power at voltages of 40,000 or above, aluminum is decidedly to be preferred, since it is found that at these voltages a wire less than one-quarter inch in diameter will discharge through the air, and this discharge may result in a considerable loss of energy. Accordingly, it is not possible at these voltages to successfully use wires less than three-tenths inch in diameter, no matter what the amount of energy or the distance. Accordingly, where the amount of energy and the distance may result in the loss not being the determining factor, aluminum is much preferable for the reason that at a definite size it is materially cheaper than copper. Where salt-sea fog is to be encountered, both aluminum and copper are acted upon. The action on aluminum is greater than the action on copper, and in consequence copper must necessarily be used. Where such conditions are not encountered, aluminum is an entirely safe material provided it is not exposed to the elements in contact with any other metal. The joints, therefore, must either be made of aluminum of the same quality as the wire, or the joints must be carefully insulated so that no moisture will penetrate. Aluminum must be strung with careful reference to the temperature at the time of erection, since its coefficient of expansion is very large, about three times the coefficient for copper, and experience in the erection of copper lines will result in an unsafe aluminum line. Careful tables have been prepared as to temperature, span and sag, and, when these tables are followed, no apprehension need be felt as to the safety of the line.

The most difficult problem at present encountered in the construction of high-tension transmission lines is that presented by the lightning arresters. For voltages up to 25,000, the non-arcing types of lightning arresters, either with or without series resistances, may be successfully used. Above this voltage and where large amounts of energy are available, these arresters are found to be short-lived, and up to the present time no thoroughly satisfactory arrester has been presented, which does not, when interrupting the ground circuit after a discharge, injure the insulation of the line and transformers. The horn form of lightning arrester developed in Germany has been found to operate with invariable success so far as the lightning arrester itself is concerned, but, as it is interrupting the ground circuit, it draws a large arc, and oscillations are produced on the line, which in many cases have been found to have more serious results than the discharge they were installed to remove. Condensers in parallel with the lightning arresters and ingenious arrangements of arresters and resistances have been used with some success, but none of these plans may be considered to be entirely satisfactory for the highest potentials operated from the largest generating plants.

In the operation of such lines every effort is made toward maintaining continuity of service. Such lines are carefully patrolled, even when it becomes necessary to build a special runway for the patrolman, and it is remarkable with what certainty these experienced men can predict the hours of life of a failing insulator, and provide for voluntary interruption of the service in time to remove the imperfection. Duplicate lines for long-distance work is an invariable necessity, though by far the best protection that can be offered for service is the supply of current from different power stations over lines following different routes. The present tendency is toward the consolidation of plants, not only for the purpose of decreasing the general operating expense, but more particularly providing continuity in the case of the most serious accidents. No difficulty is experienced in operating in parallel plants widely separated, and where a number of plants are feeding into the same network, two certain plants are assigned the regulation of the entire system, others feeding the circuit being allowed to operate their machinery at full load continuously. The line capacity offers the most serious problem in determining regulation where the loads vary widely, but this quality becomes important only for great variations of load, which as the plants increase in size and load are disappearing. When proper care has been given to the installations of the lines and where duplicate lines and plants are provided for, care in operation and patrol of the lines has resulted in success both from the engineering and financial standpoint.

A Fine Example of Night Photography.

With the spectacular illumination at the Pan-American Congress in Buffalo, many experiments were introduced in night photography. It was anticipated that the brilliant illumination of the exhibit at the World's Fair, St. Louis, would give another opportunity for night photography, and the study of the illumination from incandescent lamps with lenses of every variety and power. The accompanying illustration is made from a photograph of a night scene taken in the Palace of Electricity, which was secured by Mr. G. M. Gest, the well-known conduit contractor of Cincinnati and New York. It is unfortunate that the art of the engraver has not been able to bring out the delicate tracery and the absolute detail which the original presents. It has been sufficient, however, to render a good reproduction of a new view of this exhibit palace, in the lighting of which myriads of incandescent lamps have contributed to create an effect which is not surpassed in any other portion of the grounds.

A Fine Example of Night Photography.

Members of the International Electrical Congress, St. Louis, September 14, 1904. Photograph Taken on the Steps of Festival Hall, Louisiana Purchase Exposition.

MEMBERS OF THE INTERNATIONAL ELECTRICAL CONGRESS, ST. LOUIS, SEPTEMBER 14, 1904. PHOTOGRAPH TAKEN ON THE STEPS OF FESTIVAL HALL, LOUISIANA PURCHASE EXPOSITION.

Eighth Annual Convention of the Independent Telephone Association of the United States.

Inside Inn, World's Fair Grounds, St. Louis, September 21-23, 1904.

FIRST DAY'S SESSION.

THE eighth annual convention of the Independent Telephone Association of the United States, which was held at the Inside Inn, World's Fair grounds, St. Louis, Mo., September 21 to 23, was well attended. Marked enthusiasm was shown by the delegates and officers of the association, and each paper read proved to meet the views of those in attendance. The papers were all strong and to the point. The paper entitled "The Value of Organization," by James B. Hoge, of Cleveland, Ohio, was the keynote of the convention.

At 10 A. M. the eighth annual convention of the Independent Telephone Association of the United States was called to order by President Hugh J. Dougherty, of Bluffton, Ind. The address of welcome and "Electrical Features of the World's Fair" was delivered by Professor W. E. Goldsborough, chief, department of electricity, Louisiana Purchase Exposition, who said that the Louisiana Purchase Exposition was peculiarly adapted to a convention.

The telephone has been, preeminently, a valuable assistant in the work of building and operating the World's Fair. Stations and instruments have been installed all over the grounds ever since the fair was inaugurated and have established communication between every part of the exposition grounds.

The telephone exhibit includes a complete operating branch exchange of the Kinloch Telephone Company, of St. Louis, as well as various exhibits of apparatus. There was also shown the progress of the art from its beginning down to the present day. The interesting subject of automatic development was illustrated by fine exhibits by manufacturers of automatic apparatus.

Professor Goldsborough was followed by the president of the association, Hon. Hugh J. Dougherty, who delivered the annual address, saying:

It is not always the largest or most enthusiastic convention that accomplishes the greatest good. If there was a lacking in numbers to-day, therefore, there should not be a lacking in fealty to one another and the interests the association represented. All should bear a part of the burden of responsibility, including the manufacturer, operator and patron. This would require patience, judgment, and perseverance. The operator must concede a reasonable profit to the manufacturer, and the user of the telephone must be fair, likewise, to the operator. He qualified the national success which had come to the independent telephone movement, and paid an eloquent tribute to the Hon. James M. Thomas, his predecessor in office, who at this time was very ill. A better understanding must exist between independent operators. They must become more of one mind, and apparatus and construction must be balanced so as to best serve the public.

Mr. Dougherty was followed by a paper by Professor J. C. Kelsey, of Purdue University, La Fayette, Ind., on "What Telephone Engineering Needs."

Professor Kelsey called attention to the lack, up to a few years ago, of appreciation on the part of engineers in general, as to what constituted telephone engineering. The independent movement had offered opportunities for a great amount of engineering ability and the telephone engineer was now recognized as a valuable contributor to the wealth of the world. The National Telephone Association was doing good work in bringing forward to recognition the efforts of the telephone engineer, as were the other telephone organizations. Telephony needed no other aid than publicity to bring a sense of its proper dignity.

Mr. James B. Hoge, secretary of the United States Telephone Company, Cleveland, Ohio, read a paper on "The Value of Organization," an abstract of which follows:

"Organization is the watchword of the twentieth century. There never was a time in the world's history when the subject of organization received so much attention as at present. It is generally conceded that proper organization is a good thing but that in some cases its privileges are abused. However, that does not condemn organizations any more than the fact that laws are daily violated condemns the necessity of having national, state and municipal laws for the government of our people.

"It is now about ten years since the first independent telephone properties were put on an operating basis. Very few were put in successful operation until 1895, and comparatively few until 1896 and 1897.

"The Independent Telephone Association of the United States was organized in 1897 principally for the purpose of defending patent litigation that was then threatening the very foundation of the independent movement. The independent telephone movement has grown beyond all expectation. During the past ten years the independents have installed more than 2,500,000 telephones connected with their various systems throughout the United States.

"During the past five or six months, I have been in correspondence with various officers of a number of state associations, and find that in nearly every case they agree that the time is ripe for better organization. What we need today is uniformity of organization. There is no other business parallel to that of the independent telephone companies. In Ohio a decision has recently been handed down by the Supreme Court of the state declaring that city councils have no right to regulate rates, which was of extreme importance to nearly all the operating companies, as in many cases the early franchises provided for rates that were too low to carry on the extensive business that the companies are now doing. In practically every case, the public recognizes that they are getting a more extended and better service than they expected at the time the franchise was granted, and the early contracts entered into, and are, therefore, willing to sign new contracts at fair rates. However, the early franchises provided a means for the grandstand politicians and municipal reformers to start litigation against the various companies. This decision has, therefore, been most valuable to all independent telephone companies, and especially to those in Ohio.

"During the past eight months we have reorganized our Ohio association by dividing the state into nine districts. The state association has a president and nine vice-presidents, secretary, assistant secretary and treasurer, and an executive committee of four members besides the president, he being an ex-officio member. There is one vice-president from each district and this vice-president is president of his district. Each district has

an executive committee consisting of one representative from each county in the district. Hereafter our state association meeting will be a delegate body. Each district will elect one delegate to the state convention for each 1,000 telephones or fraction thereof they have represented by their district associations. A mile of long-distance toll line is counted as one telephone. In this way district meetings will be held quarterly or semi-annually so as to bring people with common interests together frequently to discuss subjects of special importance to the district. In this way, operating methods, rules and regulations can be standardized; meetings can be held with the loss of but very little time and at a nominal expense. The state association will take up subjects of special importance to the independent telephone interests of the entire state. We believe this plan is feasible and practicable for all the states in the Union to adopt. We believe it feasible and practicable to carry it a step farther, making an organization of the various state organizations so that the various districts would elect one delegate annually to a general convention, and the state associations at their annual meetings would elect a sufficient number at large so as to give the state one representative for each 10,000 telephones or 10,000 miles of toll line they have represented in their state associations. In that way the state delegations would be able to exchange ideas and to conduct their business on a uniform basis. Statistics can be accumulated and published that will be of special value to the independent companies. By working the entire plan out on a basis of this kind the securities of the various companies will be strengthened. The equipment of the companies will be improved upon from time to time. The disposition of two companies to parallel lines or to compete with each other in any way will be minimized. The matter of adverse legislation, national or state, can be protected. This sort of an organization would be able to get the best results from their various business and political leaders."

An informal discussion followed, participated in by Mr. Simmons, of the Atlanta Telephone and Telegraph Company, of Atlanta, Ga.; Mr. Thomas Finncane, of Rochester Telephone Company, Rochester, N. Y.; Colonel H. C. Young, Columbus, Pa.; Senator C. W. Kline, Hazleton, Pa.; E. B. Fisher, Citizens' Telephone Company, Grand Rapids, Mich.

Mr. J. B. Hoge then moved that a committee of seven be appointed by the president to bring in a report on "Organization, Benefits, and Ways and Means." This motion was seconded by Mr. T. B. Lee. The motion was carried and the chair appointed the following:

J. B. Hoge, Cleveland, Ohio, chairman; C. W. Kline, Hazleton, Pa.; H. Linton Reber, St. Louis, Mo.; J. B. Earle, Waco, Tex.; E. B. Fisher, Grand Rapids, Mich.; E. L. Barbour, Kansas City, Mo.; Cyrus Huling, Columbus, Ohio.

The convention then received an invitation to inspect the Kinloch Telephone Company's Exchange and to visit the Tyrolean Alps as the guests of the Kinloch company.

At 1.30 P. M. the meeting adjourned to 10 A. M., September 22.

After luncheon, the delegates spent a pleasant afternoon about the fair grounds. A large number visited the Tyrolean Alps. The official button of the association admitted the delegates into the Alps. The Kellogg, Automatic, and other telephone exhibits—Electrical Building—were visited by all delegates.

SECOND DAY'S SESSION, SEPTEMBER 22.

The convention was called to order by President Dougherty, at 10.30 A. M.

By special request of Mr. F. S. Dickson, president of the Cuyahoga Telephone Company, of Cleveland, Ohio, his paper was advanced on the programme and was the first paper read at this session.

Mr. Dickson's paper was thoroughly enjoyed and received with applause.

Following Mr. Dickson, Mr. Edward E. Clement, of Washington, D. C., read a paper on "The Patent Situation," prefacing it by reading a number of letters received from various prominent independents.

"There have been issued 4,298 telephone patents, of which 3,798 are in the class of telephony proper, and 500 are scattered. I do not include in this number all the patents for electric lighting, power generation and distribution which have a bearing on telephone systems, as installed, but I should say there are probably 500 more of these. The modern telephone plant is not essentially telephonic. It comprises really a power generating and distributing system, with auxiliary telegraph system whereby the supply of power is controlled. The only thing telephonic about it are the transmitters and receivers at subscribers' stations and the central office.

"Of the 3,798 strictly telephonic patents, that is, those so exhibited and classified, 327 are for receivers, 683 are for transmitters, of which 216 relate to the granular type, 469 relate to exchange systems and 715 to switchboards, of which 465 cover multiple boards exclusively, and the rest single or transfer boards. About seventy-five of the system patents also relate to multiple boards, and nearly 300 cover circuits which are applicable thereto. Ninety-five are to exclusively transfer systems, so the preponderance of choice in favor of the multiple board is thoroughly apparent. Of intercommunicating or house systems there are fifty-seven patented, and of party-line systems 577. Of the latter, 200 employ step-by-step selective mechanism.

"There are 160 patents for transmitter-arms and receiver-supports, and 211 switch-hooks. Last, but by no means least, in importance at the present time, there are 125 patents for automatic exchange systems and apparatus.

"The patents have cost: government fees, $150,430; attorney fees and expenses, $200,000; interferences, $300,000, a total of $650,430."

Senator Kline, of the committee on organization, then read the following report of the committee:

"The undersigned committee appointed to consider and report the question of the organization of this association beg leave to report that we believe the national association should be a representative body primarily selected by the state organizations of independent state associations upon the basis of the number of independent telephones owned and operated in such state, and by such other duly accredited delegates from local companies and representatives from states having no state organization for the manufacturer, as may be deemed desirable.

"We recommend that each state shall elect delegates on a basis of one for each 10,000 telephones or majority fraction thereof and for the purposes of representation one mile of toll line circuit be considered equal to one telephone, states not organized to elect delegates on the above basis by companies and each local company to elect one delegate who shall have the privilege of the floor and on all questions cast the vote of the number of telephones owned and operated by such local company. Each manufacturer of telephone supplies and such other persons as may be occupied by the manufacturing of telephones on the payment of the pre-

scribed annual fee be entitled to one full membership.

"We further recommend that a per capita tax not to exceed one cent per telephone and one cent per mile of toll line circuit be assessed on each telephone in the independent association for the purpose of defraying the expenses of the association.

"That we further recommend that a committee be appointed by this convention for the purpose of fully working out the details based on the above report and for the purpose of suggesting amendments to the present by-laws and constitution to the spirit of this report. All of which is respectfully submitted.

"JAS. B. HOGE,
C. W. KLINE,
E. B. FISHER,
J. B. EARLE,
H. LINTON REBER."

After a short discussion the report was adopted by a unanimous vote.

The president announced the appointment of the following nominating committee to present the names of officers for the following year:

E. B. Fisher, Max Reber, George Beers.

Samuel G. McMeen then read a paper on "Planning a Telephone System." A general discussion followed, participated in by Mr. Dwight Sapp, of Ohio, and Senator Flynn, of Pennsylvania, on the subject of organization.

It was then moved by E. B. Fisher, and seconded by H. D. Critchfield, that the old advisory board of the association be appointed a committee to draft resolutions of greeting and good wishes to Judge James M. Thomas, ex-president of the association, and to express the regret of the convention at his absence from the meeting. Tributes to Judge Thomas were given in short addresses by Mr. Fisher, Mr. Critchfield, Mr. Sapp, and President Dougherty.

It was moved by Mr. Edward P. Baird that the name of the association be changed to National Independent Telephone Association. This motion was tabled.

The committee on resolutions was ordered to prepare a plan of organization and to submit a new or amended constitution at the meeting on the following day.

The convention then adjourned until Friday, September 23, at 10 A. M.

THIRD DAY'S SESSION, SEPTEMBER 23.

In the absence of President Dougherty and Secretary Jones, the offices were filled, respectively, by Cyrus Huling and Frank L. Beam, both of Columbus, Ohio.

The first business before the convention was the reading and subsequent passage of the new constitution; the name of the organization becoming "The National Independent Telephone Association of America."

The committee on resolutions read a resolution of regret on Judge Thomas's absence on account of illness; the resolution was adopted and a copy ordered to be forwarded to Judge Thomas at his home at Irvington, N. Y.

The convention then proceeded to election of officers and the nominating committee placed in nomination the following gentlemen, who were unanimously elected:

J. B. Hoge, president, Cleveland, Ohio; Brickenridge Jones, first vice-president, St. Louis, Mo.; William Flynn, second vice-president, Pittsburg, Pa.; Hugh Dougherty, treasurer, Bluffton, Ind.; A. L. Tetu, secretary, Louisville, Ky.

Report of secretary was read and referred to auditing committee.

After adjournment Mr. H. D. Stroud, of the Controller Company of America, provided the delegates with Mr. E. G. Lewis's private car "Mabel" and after a trip over the Transit company's tracks entertained them at the Mercantile Club with a delightful luncheon, after which the delegates returned to the Women's Magazine Building near the fair grounds, where an inspection of this plant was made as guests of Mr. Lewis. From this point a return was made to the fair

THE DELEGATES TO THE EIGHTH ANNUAL CONVENTION OF THE INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES, SEPTEMBER 21, 1904, ON THE STEPS OF THE INDIANA BUILDING, EXPOSITION GROUNDS, ST. LOUIS.

grounds, and a visit to the Philippine exhibit was made at the invitation of the Wesco Supply Company of St. Louis, where an inspection of the apparatus furnished by this company took place; Dr. Hunt, in charge of the Ingorottes, at the request of the Wesco people having previously provided several unique features in the way of native dances for the benefit of the delegates.

Several exhibitors in the Electrical Building having issued invitations to the convention, Friday evening was devoted to an inspection of apparatus.

The Kellogg Supply Company at its exhibit distributed a handsome leather combination pocketbook to each member of the convention.

A neat paper-weight in the shape of a telephone receiver, highly nickel-plated, was given by the American Electric Telephone Company, of Chicago, as a souvenir.

The Swedish-American Telephone Company, of Chicago, gave a neat watch-fob in the shape of a telephone receiver.

The Standard Telephone and Electric Company, of Milwaukee, gave a neat button in the shape of a transmitter.

LIST OF ATTENDANTS.

Hoosier Telephone Company—J. H. Bell, Salem, Ind.

Crawfordsville Wire and Nail Company—A. Schweitzer, Crawfordsville, Ind.

Purdue University—J. C. Kelsey, La Fayette, Ind.

Marion County Telephone Company—A. A. Whitney, Mount Gilead, Ohio.

N. E. Watts, Staunton, Va.

American Electric Telephone Company—P. C. Burns, L. J. G. Ihmsen, Chicago, Ill.; S. J. Bear, Topeka, Kan.

Albert Schulter, Streator, Ill.

American Telephone Instrument Company—M. R. Nymann, Chicago, Ill.

Central Telephone and Electric Company—J. A. Becker, C. H. Wallace, J. P. Poertner, J. S. Cumming, St. Louis, Mo.

Irontown Independent Telephone Company—Jno. F. Baldwin, Jr., Irontown, Mo.

Grayson County Telephone Company—C. A. Schock, Sherman, Tex.

Lexington Improvement Company—G. T. McQuillan, Lexington, Miss.

C. H. Judson, Council Bluffs, Iowa.

P. & A. Telephone Company—F. B. Lee, Pittsburg, Pa.

Texas Telephone Company—J. B. Earle, Edward Rotau, Waco, Tex.

Cuyahoga Telephone Company—O. F. French, Cleveland, Ohio.

Morrow County Telephone Company—H. T. Dalrymple, Mount Gilead, Ohio.

Frank B. Cook—F. R. Parker, F. W. Pardee, Chicago, Ill.

W. H. Crumb & Company—W. H. Crumb.

The United States Telephone Company—Jas. B. Hoge, Cleveland, Ohio.

American Electric Fuse Company—Frank G. Jones, F. W. McNeal, James A. Kenny, Chicago, Ill.

Swedish-American Telephone Company—T. Lidberg, J. A. Russell, A. V. Overshiner, Chicago, Ill.

Baird Manufacturing Company—Edw. P. Baird, Chicago, Ill.

Telephone Hygienic Company—Arthur Kneisel, St. Louis, Mo.

Oscar Wentworth Rogers, New York, N. Y.

Harvard Electric Company—Frederick Greer, Chicago, Ill.

L. W. Stanton, Cleveland, Ohio.

Stromberg-Carlson Manufacturing Company—C. W. Steiger, J. P. Cracraft, Thos. W. Finucane, Chicago, Ill.

Automatic Electric Company—J. F. Crook, G. L. Fisher, Harry Durant, James Strasberg, H. D. Critchfield, A. J. Rousseau, Chicago, Ill.

Interstate Telephone Company of New Jersey—C. W. Kline, Hazleton, Pa.

Consolidated Telephone Companies of Pennsylvania.

Maxime Reber, St. Louis, Mo.

Hubbard & Company—Carl Seyler, Pittsburg, Pa.

Roebling's Sons Company—A. B. Conover, George C. Baily, Chicago, Ill.; W. P. Bowman, Cleveland, Ohio.

T. L. Dean Electric Company—A. E. Barker, Elyria, Ohio.

H. E. Young, Columbus, Pa.

Edward E. Clement, Washington, D. C.

American Electric Works—F. E. Donohoe, Chicago, Ill.

United Telephone Company—Hugh Dougherty, Bluffton, Ind.; P. J. Wenich, Monroe, Wis.

North Electric Company—A. B. Kratz, Cleveland, Ohio.

Wm. A. Hopkins, Jr., Columbus, Ohio.

American Conduit Company—A. L. Waterbury, Chicago, Ill.; C. M. Ripley, St. Louis, Mo.

Standard Underground Cable Company—W. A. Caldwell, St. Louis, Mo.

Commercial Electric Supply Company—Wm. Montrove, St. Louis, Mo.

Wesco Supply Company—Jno. C. Ecoff, St. Louis, Mo.

C. Nicholas, Columbus, Ohio.

Dwight E. Zapp, Mount Vernon, Ohio.

Measured Service Company—Wm. E. Metzell, Chicago, Ill.

Federal Telephone Company—C. Y. McVey, Cleveland, Ohio.

L. F. Blasingam, Hawkinsville, Ga.

Home Telephone Company—O. C. Snider, Kansas City; James Bailey, Jr., Toledo, Ohio.

Columbus Citizens' Telephone Company—Frank L. Bean, Columbus, Ohio.

Standard Underground Company—J. R. Wiley, Chicago, Ill.

The Suttle Electric Company—C. H. Torlle, Cleveland, Ohio.

E. Land, Grand Rapids, Mich.

Cyrus Huling, Columbus, Ohio.

E. B. Fisher, Grand Rapids, Mich.

Controller Company—H. D. Stroud, Chicago, Ill.

E. L. Barber, Wauseon, Ohio.

Sterling Electric Company—W. E. Doolittle, La Fayette, Ind.

Dean Electric Company—W. W. Dean, Elyria.

Ewing-Merkle Electric Company—L. G. Le Bourveau, St. Louis, Mo.

Monarch Telephone Manufacturing Company—W. H Trimn, J. C. Hubecher, Chicago, Ill.

North Electric Company—F. F. Sapp, Cleveland, Ohio.

Virgil Bunton, Lebanon, Ind.

Western Telephone Manufacturing Company—G. H. Johnson, Chicago, Ill.

Lebanon Telephone Company—J. W. Sidener, John Wallas, Ira J. Baker, Lebanon, Ind.

Henry County Telephone Company—Lee Henry, New London, Iowa.

C. E. Stinson, Toledo, Ohio.

Newark Telephone Company—Guy Watkins, Newark, Ohio.

Gordon Battery Company—E. W. Deems, Chicago, Ill.

Central Telephone Association—Jas. McClamwel, Frankfort, Ind.

Suburban Telephone Company—H. W. Kanenbroch, St. Louis, Mo.

J. B. Greensfelder, St. Louis, Mo.

Marysville Telephone Company—N. E. Liggett, Marysville, Ohio.

C. S. Brown, Aberlene, Kan.

J. C. Myers, De Graff, Ohio.

D. O. Godis, Toledo, Ohio.

P. E. Allison, Atlanta, Ga.

Geo. H. Metheany, Lima. Ohio.

Will Van Middlesworth, Racine, Wis.

K. B. Miller, Chicago, Ill.

Kellogg Switchboard and Supply Company—F. V. L. Turner, Chicago, Ill.

A recent report has it that a Portland, Ore., man has perfected a telephone arrangement by which one may see the party to whom he is talking.

Changes Affecting the Customs Laws Enacted by the Canadian Government.

Mr. N. B. Colcock, vice and deputy United States consul, Niagara Falls, Canada, announces that several important changes affecting the customs laws have recently been enacted by the Canadian government, the same to go into effect on October 1. Special attention is directed to the following new provisions in the regulations: one, duplicate invoices on approved form required for customs entry; two, new certificate on invoice form "M," instead of form "J"; three, new declaration on invoice of goods shipped on consignment, form "N" instead of form "6." It is required that invoices from exporters to importers in Canada shall show the marks and numbers on the packages in such a manner as to indicate truly the quantities and values of the articles comprised in each exporter's package, the packages to be legibly marked and numbered on the outside when of such a character as to enable such marks and numbers to be placed thereon. Manufacturers and shippers can obtain a copy of the official circular to exporters free of charge by addressing Mr. Colcock.

The Municipal Telephone in Great Britain.

The municipal telephone system in Great Britain seems to be serving very satisfactorily. At present exchanges are either operating or in course of construction in Glasgow, Portsmouth, Brighton, Swansea and Hull. With the exception of the London post-office system, the Glasgow plant is the largest underground service in England.

It is estimated that the cost of the gas and electric plant being built on the Hackensack meadows will reach one million dollars. This will furnish light, heat and power to Newark, Jersey City and adjoining towns, and will be one of the largest plants in the United States.

The Southern Pacific Electrification of Suburban Lines.

The Southern Pacific Railway Company has nearly completed plans for electrifying its suburban lines in California connecting Oakland, Alameda and Berkeley with San Francisco. The expenditure of five million dollars has been authorized for these improvements. Both plans of transmitting current have been tried in California and it is probable that this latest addition will make use of the third-rail system.

Farewell Supper to the Institution of Electrical Engineers, of Great Britain.

A most enjoyable farewell supper was given by President R. Kaye Gray, of the Institution of Electrical Engineers, of Great Britain, at the Waldorf-Astoria, New York city, Friday evening, September 23. The tables were laid in the Myrtle room for about seventy guests. Among those who attended were President Bion J. Arnold, of the American Institute of Electrical Engineers; President-elect John W. Lieb, Jr.; Colonel R. E. Crompton, Dr. R. T. Glazebrook, Professor John Perry, Miss Perry, Theodore Fielden, Arthur Williams, Mr. and Mrs. E. H. Mullin, the Hon. M. Hayashi, Charles L. Edgar, president of the Edison Electric Illuminating Company, Boston, Mass.; Samuel Insull, president of the Chicago Edison Company; L. B. Stillwell, Robert Hammond, Ralph W. Pope, Gano S. Dunn and Dr. S. S. Wheeler.

A number of addresses were made. President Gray thanked the American Institute of Electrical Engineers and the local committee for their hospitality and thoughtfulness in providing for the foreign members.

Colonel Crompton expressed the visitors' appreciation of the courtesies shown them by the manufacturing and operating companies, which had thrown open their shops and plants to the visitors and had allowed them to see everything there was to be seen.

Mr. Edgar expressed the pleasure of the American engineers in receiving the foreign guests, and said that, while we were sorry to have them go, we took a great deal of pleasure in speeding the parting guest.

Mr. Insull, in an interesting little talk, spoke of the importance of the electric lighting field, and urged the British engineers to revise the methods in use in London. A much better service would be possible if the numerous small companies could be brought together and consolidated.

Mr. Mullin spoke of the size of this country, and pointed out to our foreign guests that they had as yet seen but a small part of it.

Toasts were offered by President Gray to the Institute and President Arnold, and to the ladies; and by President Arnold to President Gray.

At the conclusion of the dinner the guests assembled in the east reception room, where the visiting engineers presented Mrs. E. H. Mullin with a beautiful silver cream and sugar set. Mrs. Mullin, in a neat and appropriate little speech, expressed her pleasure and appreciation. Mr. Ralph W. Pope was also presented with a handsome bridge whist set in a silver casket, and Mr. T. C. Martin, chairman of the general reception committee, was the recipient of a silver cigarette case.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION.

SECOND ANNUAL MEETING, HELD AT COLORADO SPRINGS, SEPTEMBER 21, 22 AND 23.

The second annual meeting of the Colorado Electric Light, Power and Railway Association was held at the Antlers Hotel, Colorado Springs, Col., September 21, 22 and 23. Sessions were held both in the morning and afternoon, and a number of valuable papers were read and discussed. In addition to the routine business, the following papers were presented:

"Notes on Induction Integrating Wattmeters and Their Use," A. A. Serva; "The Curtis Steam Turbine," P. J. Brown; "Commercial Testing of Transformers," C. W. Humphrey; "Modern Large Gas Engines, with Particular Regard to Their Suitability to Central Stations," H. L. Woolfenden; "Electric Track Switches for Street Railway Work," W. G. Matthews; "Lightning Arresters," J. E. V. Titus; "A Description of the Power Plants in and Adjacent to Colorado Springs," E. P. Dillon.

In addition to these papers there was a question box containing a number of questions taking up, in separate departments, management, dynamos and motors, boilers and engines, lightning arresters, transformers, wiring, lamps, pole lines and miscellaneous.

The convention closed on Friday afternoon, September 23, with the election of officers for the ensuing year as follows:

President, J. A. Beeler, general manager of the Denver City Tramway Company; vice-president, C. E. Doolittle, manager of the Roaring Fork Electric Light and Power Company; secretary, George B. Tripp, general manager of the Colorado Springs Electric Company.

The following committees were appointed:

Executive committee, J. A. Beeler, John F. Vail, George B. Tripp and William Mayher; finance committee, C. W. Humphrey, F. C. Webber and J. E. Lundstrom; membership committee, J. J. Coohr, Charles Chamberlain and C. H. Peters.

Special trips were arranged to visit the central stations near Colorado Springs, together with a visit to the lignite coal mining district. Other forms of special entertainment were arranged, and, after adjournment, the delegates visited the plant of the Pike's Peak Hydroelectric Company, in course of construction, at Manitou.

Report of the Committee of the New York State Street Railway Association on the Danger of High-Voltage Lines.[1]

The committee, in their investigations, have assumed that the principal objects to be attained were the determination of the conditions under which high-voltage power-transmission lines become dangerous to the general public, and also to determine, if possible, the proper measures to be taken for the prevention of such dangers. With this end in view and by the courtesy of Mr. C. Loomis Allen, general manager, and Mr. W. J. Harvie, electrical engineer of the Utica & Mohawk Valley Railway Company, of Utica, N. Y., a short transmission line was erected and arrangements made to conveniently subject the conductors to the worst possible conditions that might arise in the operation of any high-voltage line.

This experimental line was built on the railway company's property adjacent to its Frankfort substation, which is supplied with 20,000-volt, three-phase, sixty-cycle, alternating-current power generated at the Trenton Falls water-power plant of the Utica Gas and Electric Company. Poles Nos. 1, 3 and 6 are cedar; poles Nos. 2 and 5 are chestnut; and pole No. 4 is of iron, being a standard four-inch, five-inch, six-inch tubular type, twenty-eight feet long. The wooden poles are thirty-five feet in length and set to a depth of seven feet. Poles No. 2 and 4 are set in concrete and the others set in earth in the usual way.

For convenience the poles are numbered, beginning with the one adjacent to the substation.

A double set of cross-arms was provided, the upper one carrying four conductors and the bottom one two, arranged so that the wires on each side of the pole formed an inverted triangle approximately twenty-four inches on a side. The wires on one side of the poles were copper, and those on the opposite side of aluminum, all being mounted on Locke No. 100, chocolate-colored insulators. Tests were made, however, only on the aluminum conductors. The upper cross-arm was seven feet five inches long, and the lower one, five feet four inches long, both being four and three-quarter inches by four inches. These cross-arms are set in gains and fastened on with a single bolt passing through the pole and supported by a one-piece galvanized iron brace which is lag-screwed to the pole and bolted to a small angle iron attached to the arm.

The above is the standard type of construction used by the Utica & Mohawk Valley Railway Company.

The cross-arms on the iron pole were held in place by a collar and bolts, no braces being used.

In order to obtain the necessary high-voltage current without causing trouble to the main transmission system, two 330-kilowatt, oil-insulated, self-cooling transformers were supplied and connected so as to receive current at 360 volts, raising it to 20,000 volts, for use on the experimental line. The transformers were V-connected so as to transform from three-phase to three-phase, giving regular working conditions. The switching of the current was all done in the low-voltage side of the transformers in which there was also connected three alternating-current ammeters supplied by the Westinghouse Electric and Manufacturing Company for use during the tests. One meter was connected in each phase. The voltmeters used were of the Weston portable, alternating-current type, and a Westinghouse static ground detector, reading from 0 to 3,000 volts, all of which had been recently calibrated.

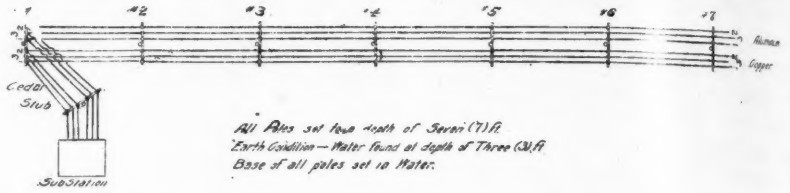


FIG. 1.—ARRANGEMENT OF THE TRANSMISSION LINE AND POLES.

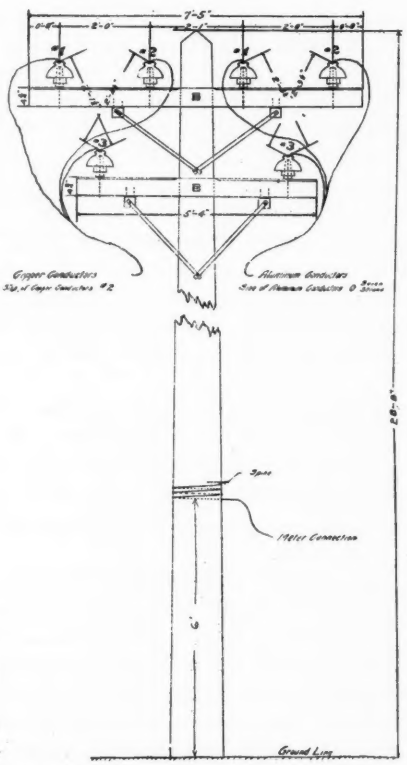


FIG. 2.—ARRANGEMENT OF CROSS-ARMS, INSULATORS AND WIRES.

One of the Weston meters had a double scale for either 150 or 300 volts and the other one a double scale for 300 or 600 volts.

In order to approximate the conditions which might be met by a person leaning against a pole and receiving a shock, due to possible leakage through the pole or over its surface, an aluminum cable was wrapped around poles No. 2 and No. 3 about six feet from the ground, three turns being taken around each pole and a connection to the centre of the pole being made by a large spike driven into the pole and around which the ends of the aluminum cable were fastened. The difference of potential between this aluminum band around the pole and the ground would represent the maximum shock or voltage obtainable by any person leaning against the pole or coming in contact with it.

With the line in normal operating condition, either wet or dry, it was impossible to find any difference of potential between these points as determined either by voltmeter or by personal contact; nor could any be found when different wires were laid on cross-arms on adjacent poles until they were tied to the iron braces.

With one conductor removed from the insulator and lying on top of the cross-arm, as well as being connected to the iron brace, no leakage was obtainable with the pole dry; with the pole wet after a twelve hours' hard rain the Weston voltmeter showed a difference of potential of ninety volts. The shock obtained by personal contact was somewhat in excess of this amount owing to the higher resistance of the human body than that of the voltmeter. The closing of the voltmeter circuit between the aluminum band wire and the ground would materially reduce the shock.

In order to obtain severe conditions one of the other conductors was removed from its insulator on pole No. 3, laid on the cross-arm and connected to the iron

[1] Read at the convention of the New York State Street Railway Association at Utica, N. Y., September 18.

brace exactly in the same manner as on pole No. 2. This arrangement gave a difference of potential of 20,000 volts between the two cross-arms on pole No. 2 and pole No. 3, and is the shortest path obtainable for the current flowing through the entire length of the poles and the intervening ground.

Under these conditions with both poles soaked after a twelve hours' hard rain, the difference of potential between the band wire on No. 2 pole and the ground was 270 volts, and that between the band wire on No. 3 pole and the ground was 170 volts. This difference was probably due to the fact that the one showing the higher difference of potential was set in concrete, while the other was in wet earth. This shows that the resistance of the concrete, even though wet, is considerably higher than that of wet earth.

As the worst possible conditions, the third wire of this line was removed from its insulator and laid on the cross-arm supported by the iron pole. It will be noted that this arrangement gave all three phases with conductors removed from their insulators and laid on the cross-arms of three consecutive poles—the two wires on the wooden poles being in addition tied to the iron braces—one of the poles of iron and the two wooden ones were water-soaked after a heavy rain. Between the band wire on pole No. 2 and the ground the voltmeter indicated 320; between the band wire on pole No. 3 and the ground the voltmeter indicated 300; while between the iron pole and the ground there was no difference of potential—showing that although set in concrete its base probably extended through to wet earth, making a good ground.

The voltmeter was then connected in circuit between the band wire of pole No. 2 and that on pole No. 3, showing a difference of potential of 370 volts, which by calculation from current and voltmeter resistance shows a resistance of approximately 1,400 ohms between these two points. During a later test after several days of dry weather, the poles having been wet down with a hose, the resistance of pole No. 2 from the band wire to the ground was determined as approximately 1,780 ohms, a static voltmeter being used. This difference in resistance is due to the fact that in the later test the body of the pole contained less moisture than in the first test. The later tests also seemed to show that at least seventy-five per cent of the total drop in potential occurred at the point of contact between the brace or lag screw and the pole.

It should be noted that, as stated previously, the shock obtainable by a human being would be considerably in excess of that indicated by a Weston voltmeter and would be correspondingly less than that indicated by a static voltmeter.

The above results were obtained by using a line voltage of 20,000, but the effect of increasing or decreasing the line voltage would be to modify the results obtained in practically the same proportion.

The most interesting experiment performed was for the purpose of determining the possible danger to persons standing on the ground and holding a hose throwing a stream of water on either a trolley wire or a high-voltage transmission line. For the purpose of this demonstration a fire engine was secured from the village of Frankfort and placed so as to take water from the Erie canal, which is within about 300 feet of the substation. A line of three and one-half inch hose with a one and one-eighth inch nozzle was carried to the experimental line, the nozzle being placed at an angle of about sixty degrees and throwing the stream directly on the 600-volt trolley wire, and later on the 20,000-volt transmission wires. In neither case was it possible to obtain the slightest shock even while standing on the rail or the wet ground and holding the brass nozzle in the bare hands. The length of the stream from nozzle to trolley wire was about twenty feet and about thirty feet to the transmission wires.

It was also found that it was impossible to short-circuit the 20,000-volt line even by throwing the stream so as to strike two of the wires, which, as stated previously, are only twenty-four inches apart; nor did any change in the ammeters in circuit indicate that any current passed between the two wires over the stream of water.

The series of tests indicates that under certain possible conditions of high-voltage transmission, wooden poles may become sufficiently charged to render them dangerous. These conditions while possible are, however, extremely improbable, but it is nevertheless advisable that proper means be devised for affording necessary protection; and we therefore offer the following suggestions in relation to such protection.

It was shown that when the band wire which was wrapped around the wooden poles was grounded it was practically impossible to obtain a shock by standing on the ground and touching any portion of the pole below the band wire. We, therefore, suggest that all wooden poles in exposed locations, which are carrying high-voltage transmission lines, be supplied with a metal band placed tightly around the pole about six feet from the ground and permanently and durably connected to the ground.

Where iron poles or towers are used if they are merely set in earth, no protective device of the above character is required. If they are set in concrete there might be a slight shock obtained if the concrete was very dry and covered every portion of the pole where placed in the ground. This condition can be avoided by having the pole project several inches through the concrete into the earth. Galvanized iron poles or towers set in earth without the use of concrete are, therefore, preferable as regards safety from accidental shock over any other type.

For protection from possible danger due to wires carrying a high voltage breaking and lying on the ground, we would suggest that poles or towers in exposed places be fitted with thoroughly and permanently grounded iron shields or brackets which extend on each side of each pole and cross-arm to a sufficient distance and at a proper height so that a break in the wire would cause the ends to come immediately in firm contact with the grounded shields by dropping upon them. In this case no one could receive a severe shock from the broken ends which might be lying on the ground or suspended within reach, as the wires would be at the same potential as the earth on which the person was standing.

A grounded network suspended under the transmission wires, if properly installed, would accomplish the same results.

The suggestions embodied above are the results of experiments conducted on three different occasions under widely varying conditions.

The committee feel that this is a highly important subject and demands further investigation before final recommendations are made.

The Telephone Installation of the Minnesota.

The Minnesota, a steamship recently built for the Great Northern Steamship Company, has the largest telephone system ever placed on board a vessel. The system consists of two installations, an intercommunicating and a regular exchange. Central energy is employed. It is really a combination of the annunciator with telephone attachment. The switchboard may be connected with the local system in any city at which the boat docks, so that parties on board can have all the advantages of local telephone subscribers. By means of a special key two pairs of cords may be connected and four parties may converse on the boat at one time.

Luncheon to Sir Alfred Harmsworth.

Mr. Pomeroy Burton, of the New York *Daily World,* gave a luncheon and reception to his friend, Sir Alfred Harmsworth, of the London *Mail,* at the Manhattan Club in this city last week. The occasion was an unusually pleasant one, and there were no vacancies at the well-provided table. Sir Alfred, on being called upon, paid a glowing tribute to American enterprise, and expressed his appreciation of the personal benefits he had received through meeting the newspaper men of this country and investigating their energetic publishing methods. He takes great interest in the development of rapid transit, electricity and of the telephone service of London and New York, and says there is a noticeable improvement in London telephoning over what it was three years ago.

Those in attendance, besides the host and guest of honor, were: Dr. Newell Dwight Hillis, pastor Plymouth Church, Brooklyn; District Attorney W. T. Jerome; Alexander Black, author and artist; Randolph Guggenheimer, former president Municipal Assembly; John A. Sleicher, editor *Leslie's Weekly;* Alfred Henry Lewis, the author; Arthur Brisbane, editor *Evening Journal;* Charles W. Price, editor ELECTRICAL REVIEW; the Hon. Elijah R. Kennedy, ex-park commissioner of Brooklyn; William H. Merrill, editor of the *World;* Dr. S. D. McConnell, rector All Souls Church, New York city; Bradford Merrill, of the *World;* Herbert F. Gunnison, business manager *Brooklyn Eagle;* J. O'H. Cosgrove, editor *Everybody's Magazine;* George H. Daniels, editor *Four-Track News* and general passenger agent New York Central & Hudson River Railroad; Dr. Chester S. Lord, managing editor of the *Sun;* Frank Presbrey, of the Presbrey Advertising Agency; Colonel William Hester, president of the *Brooklyn Eagle;* James Creelman, war correspondent and author, now of the *World.*

Telephone Information Bureaus.

The German imperial postal department, says the *Telephone Magazine,* has ordered special enquiry offices to be established in connection with telephone exchanges. Information as to the transfer or discontinuance of telephone connection, working hours, disturbance in the lines, and similar matter will be given from these offices. The working force will be drawn from those assistants who have acquired a thorough knowledge of the telephone service.

THE CONVENTION OF STREET RAILWAY MEN AT ST. LOUIS.

THE THREE NATIONAL BODIES OF STREET RAILWAY MEN MEET DURING THE WEEK OF OCTOBER 10.

The twenty-third annual meeting of the American Street Railway Association will be held October 12 and 13, 1904, in the Transportation Building, exposition grounds, St. Louis. A fine programme of entertainment has been prepared by the manufacturers interested in street railway equipment. It is expected that a large number will be drawn to St. Louis during the week of October 10, which is designated as Street Railway Week. At the meetings of the American Street Railway Association, papers will be presented on "Steam Turbines," "Reciprocating Engines," "Gas Engines," "Transfers, Their Uses and Abuses," and "Signals." The headquarters will be at the Southern Hotel.

The American Railway, Mechanical and Electrical Association will hold meetings in the Transportation Building, in the World's Fair grounds, on October 10, 11 and 14, 1904.

The Street Railway Accountants' Association of America will hold a meeting on Thursday, October 13, in the parlor of the Inside Inn. On Friday and Saturday, October 14 and 15, meetings will be held on the second floor of the Transportation Building.

Edison Laboratories Visited by the Institution of Electrical Engineers, of Great Britain.

One of the interesting trips made by the Institution of Electrical Engineers, of Great Britain, before leaving for England was to the Edison laboratories at West Orange, N. J. A special train carrying the visitors left Jersey City on Friday, September 23, and conveyed them to West Orange without delay. Among those on the train were President R. Kaye Gray, of the Institution of Electrical Engineers, of Great Britain; President Bion J. Arnold, of the American Institute of Electrical Engineers; Dr. R. T. Glazebrook, Colonel R. E. Crompton, the Hon. M. Hayashi, and Mr. Robert Hammond, an old personal friend of Mr. Edison. Mr. Edison was assisted in receiving his guests by Mrs. John R. Schermerhorn and Miss Edith Edison, a niece of the inventor. A pleasant time was spent in examining the laboratories and talking over the new work going on. The party then returned to New York.

Official Opening of the Rapid Transit Subway, New York City.

The date announced for the official opening of the rapid transit subway is October 27. It is understood that elaborate ceremonies will mark the public opening of this system. While the programme has not been completely arranged, it has been decided that there will be three centres of celebration—City Hall Park, Times Square and the park surrounding the borough hall in the borough of the Bronx. The principal ceremonies will take place at City Hall Park. The programme provides for a prayer by Bishop Potter and an address by Alexander E. Orr, president of the Rapid Transit Commission. Mayor McClellan will accept the subway for the city, and then turn over the road to August Belmont, president of the Interborough Rapid Transit Company. The Chamber of Commerce is to give a banquet either on the night of opening or the following evening. It is expected that a number of prominent engineers will be invited to attend the ceremonies.

The International Engineering Congress.

The International Engineering Congress, to be held under the auspices of the American Society of Civil Engineers, St. Louis, Mo., October 3 to 8, 1904, will be divided into eight sections, as follows: section A—waterways; Alfred Noble, chairman; section B—municipal; J. James R. Croes, chairman; section C—railroads; Robert Moore, chairman; section D—materials of construction; Frederick P. Stearns, chairman; section E—mechanical; William Metcalf, chairman; section F—electrical; Frank J. Sprague, chairman; section G—military and naval; William P. Craigkill, chairman; section H—miscellaneous; Octave Chanute, chairman.

The papers promised for section F (electrical) are by James G. White and Alexander Siemens, on "The Substitution of Electricity for Steam as a Motive Power," and by L. B. Stillwell, on "Electric Power-Generating Stations and Transmission."

The joint meetings will be held in Convention Hall, Administration Building. The meetings of the various sections will be held in separate rooms in the Administration Building and vicinity. Each section will have four sessions, of from two to three hours each, for the discussion of papers.

The committee in charge is as follows: Henry Haines, chairman, Detroit, Mich.; L. F. G. Bouscaren, vice-chairman; Charles Warren Hunt, secretary, New York city; Joseph M. Knapp, treasurer.

LETTER TO THE EDITOR.

A Danish Detinning Works.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

I have read with great interest the article in your honored paper of June 18, headed "Tin Scrap Recovery," by Mr. John Kershaw. Of special interest to me is that part of the article in which Mr. Kershaw mentions the enormous quantity of old cans which are not yet worked to regain the tin and iron contained therein.

When we realize that the greater part of the tin produced in the world is used for cans, and almost all of it is lost—partly as tinning and partly as solder—it will be easily understood how important the regaining of this tin would be. The tin plate which is worked only forms a small part—fourteen to twenty per cent—of the tin plate produced. The experiment of heating old cans in a furnace, in which the solder melts and can be collected, has been tried. Such works are, as far as I know, to be found in London and Paris. This method has its drawbacks, however, because, first, only the tin-lead alloy, which forms the solder, is gained. This is only two per cent of the weight of the cans, and half of this is tin; second, it is not possible to recover all the tin which forms the tinning, because the layer is too thin to drip off. This amount of tin is three per cent of the weight of the scrap. The worst part, however, is that this tin directly hurts, getting into the iron and forming an alloy with same, whereby its value is lessened. The tendency of the tin to form an alloy with the iron is so great, that it is impossible to entirely prevent it in making tin plate. Every tin plate contains, besides tin and iron, a tin-iron alloy, the so-caled "Härtling." The amount of tin therein is 0.1 to 0.4 per cent.

For the past two years we have had a factory here in Copenhagen, which works the cans gathered from garbage. This factory works with the so-called "Bergse" process. It is possible by this process to regain all the tin, not only in the tinning, but also in the solder. The cans are worked without cleaning. A hole is cut in the bottom of the cans by a machine or by hand, whereafter they are thrown into baskets of angle iron and iron twist, in which they remain during the detinning. At the same time a separation takes place; the lacquered cans being thrown into a separate basket. The separation and perforation when made by hand cost 3.50 kroners per ton, equal to about $1. When filled the baskets are brought to the leaching tanks, where the detinning takes place. These tanks are placed in series and connected in such a manner that the leaching liquid can stream from the first into the second, from the second into the third, and so on. For the detinning of ten tons of cans a day and night 100 cubic metres of tanks are necessary. The leaching liquid streaming out from the electrolytic cells is a solution of chloride of tin containing about two per cent of tin. This solution removes the tin forming stannous-chloride after the formula:

$$SnCl_4 + Sn = 2SnCl_2$$

During its way from tank to tank the amount of stannous-chloride increases. It is pumped from the last tank by a small brass pump and distributed to the electrolytic cells and streams through them. Undissolvable anodes are used, and the process here taking place is the contrary of what takes place in the leaching tanks, *viz.*:

$$2SnCl_2 = Sn + SnCl_4$$

The tin is precipitated in small crystalline prisms of one-half centimetre in length, and the liquid streams back to the leaching tanks as stannic chloride, able to again dissolve tin. The tin thus gained is easily melted down in an open crucible and is so pure that it is sold at the same price as bankatin. An electric current of forty-seven kilowatts or sixty-five electric horse-power per 1,000 kilos tin is used, or only half as much as in the alkaline process. The cells are so constructed that the tin falls down to the bottom, where a scraper moves longitudinally, driven by belts moving over a roller. By turning the roller the tin is scraped toward a shovel and can thus be taken up.

The leaching liquid can be used for three or four months, when it must be rejected as it has considerable iron in the solution.

The iron dissolved is proportionally small, twenty per cent of the weight of the gained tin. Hydrochloric acid, which is very expensive here in Denmark, is used in the solution of the iron, so that the expense for chemicals is $1 per ton of scrap. The tin solution is produced by leaching of scrap, adding oxidizing substances, or still cheaper, by dissolving old tin in acid.

In the alkaline process, where the whole process lasts only twenty minutes, the solder is almost unattacked. In the Bergse process all the solder touched by the liquid is removed, and only a grayish residue, consisting of chloride of lead, is left. This process thus offers the great advantage of regaining all the tin.

One of the greatest expenses at the alkaline process is due to the necessity of keeping the electrolyte at seventy degrees centigrade. The Bergse process works at ordinary temperatures (about twenty degrees centigrade), and heating is necessary during the winter-time only.

It is remarkable that no more iron than above mentioned is dissolved. This, of course, was the great question until the process had been tested on a large scale; but this matter has turned out as favorably as above stated. While stannic chloride only dissolves this small quantity of iron, and then not till all the tin is removed, this is not the case with ferric chloride, which dissolves iron as easily as tin. In the electrolysis no ferric chloride is formed, when the quantity of tin is sufficiently great. Only when the amount of tin is lowered to a certain degree will this take place; but this is easily prevented by increasing the amount of tin.

The detinned iron is bought at a good price here in Scandinavia by cement-copper works, as being free of rust, it is better than other iron scrap.

All the dirt from the cans gathers on the bottom of the tanks, and is cleaned away a few times a year; sand, coal, paper and dirt are thus gathered, and taking into consideration that in the alkaline process all these substances are mixed with the tin regained, together with the rust always present, it will be easily understood that the working of the cans by the alkaline process offers enormous difficulties.

C. V. SCHOU.

Copenhagen, September 8.

Institution of Electrical Engineers.

The August issue of the Journal of the Institution of Electrical Engineers, of Great Britain, contains the valuable paper by Mr. Alexander Siemens, on "High-Speed Electric Railway Experiments on the Marienfelde-Zossen Line," and one by Mr. M. B. Field, entitled "A Theoretical Consideration of the Currents Induced in Cable Sheaths, and the Losses Occasioned Thereby." These two were read at general meetings. This number also contains the following papers, read at the Birmingham local section: "The Equipment of an Engine Test-House," by R. K. Morcom, and "Some Uses of the Oscillograph," by D. K. Morris and J. Catterson-Smith. A paper on "The Mersey Railroad Multiple-Control," by H. L. Kirker, read before the Manchester local section, and one by Mr. H. O. Wraith, entitled "A Description of the Electrical Equipment of an Engine Works and Shipyard, with Notes Thereon," read before the Leeds local section, are also given in this issue. All of these papers are accompanied with the discussions which followed their reading.

THE "CIRCULAR TOUR" OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS AND ITS GUESTS, AT WASHINGTON, D. C.

BY GEORGE C. MAYNARD.

The entertainment of the members of the American Institute of Electrical Engineers and their foreign friends, by the Washington electrical contingent, commenced at Pittsburg, where the distinguished tourists were met on Sunday, September 18, by Mr. Philander Betts, electrical engineer of the Potomac Electric Power Company, who represented the Washington reception committee, and who tendered them a cordial welcome to the National Capitol and distributed the souvenir guide books. During the two days spent with the party Mr. Betts made the personal acquaintance of a large number of the members, thus preparing himself for introducing them to the people they were to meet in Washington.

The party reached Washington on schedule time by the special train on the Pennsylvania Railroad, and immediately proceeded to the new Willard Hotel, at the corner of Pennsylvania avenue and Fourteenth street, where breakfast was awaiting them in a dining-room especially reserved for their use. General George H. Harries, president of the Washington Railway and Electric Company, chairman of the reception committee, greeted the visitors as they arrived at the hotel. Other members of the committee in attendance were Colonel Samuel Reber and Major John Biddle, of the United States Army; Mr. O. H. Tittmann, superintendent United States Coast and Geodetic Survey; Mr. Bernard R. Green, superintendent of the government library; Professor H. L. Hodgkins, dean of the George Washington University, who represented President Needham; Professor R. A. Fessenden, of wireless telegraph fame; H. W. Fuller, general manager, and L. E. Sinclair, superintendent, of the Potomac Electric Power Company; George C. Maynard, of the National Museum, and Proctor L. Dougherty, besides other local members of the American Institute of Electrical Engineers.

At nine o'clock a well-equipped, special electric train stopped on Pennsylvania avenue in front of the hotel, took on board the entire party, which included many ladies, and ran directly to the Bureau of Standards, located about one mile north of the city. Arriving at that place, the party spent an hour or more in strolling about the buildings, examining the apparatus, which consisted mainly of steam engines, electric generators, primary and storage batteries and other machinery, with which most of the visitors appeared quite familiar. Dr. S. W. Stratton, director of the bureau, greeted the visitors very cordially, and, in his happy manner, explained that the working laboratories of his bureau are still located in the temporary quarters on Capital Hill, that the most interesting part of the new outfit is on exhibition at St. Louis, where it had already been viewed by the electrical engineers, and that what they were examinng to-day is the foundation of the bureau as it is to be. He stated that one of the buildings was completed about three months ago, that the other will be completed about three months hence, and that this would account for the somewhat crude and unfinished condition of things as they existed to-day. At the close of this examination, the party again embarked in the special train which rapidly returned to the city and proceeded down Pennsylvania avenue to the Capitol. Half an hour was given to a visit to that building, and another half hour to an inspection of the Congressional Library Building. The visitors, under the leadership of Superintendent Green, were escorted through the building and given an excellent opportunity of examining the practical operations of the establishment. Mr. Herbert Putnum and Mr. A. R. Spofford, who probably knows more about books than any one else in the United States, gave the visitors a cordial welcome and largely contributed to their pleasure. The library building, which is the newest and best building in Washington, and probably the newest and best library building in the world, was greatly admired and enjoyed. At one o'clock an elegant buffet lunch was served in the restaurant on the upper floor of the building, to which Lieutenant-General Adna R. Chaffee, United States Army; General Alexander McKenzie, chief of engineers; General A. W. Greely, chief signal officer; Commodore George W. Baird, of the United States Navy; Elliott Woods, superintendent of the Capitol; Assistant-Secretary of the Treasury Armstrong and the public printer had been invited to meet the foreign guests, with some of whom they were personally acquainted. The affair was quite informal and was enjoyed by all present in friendly greeting and social conversation. At the close of the lunch, the visitors were asked to express their preference for any one of several trips to points of interest, members of the local committee having been assigned to act as their escorts. One party visited the White House, the treasury department, the state, war and navy department building, and the Corcoran art gallery. It had been hoped that the president would be able to receive the visitors, and Mr. Roosevelt was quite anxious to meet them, but the exigencies of official business prevented his returning to the city at this time.

Another party went to the navy yard, where they were officially welcomed by the commandant, Captain E. C. Pendleton, and shown through the very extensive ordnance shops, the wireless telegraph station and the naval experimental basin, in which the best forms for the hulls of battleships are determined by elaborate tests.

Calvin W. Rice, with a party of ladies and a number of members of the three electrical institutions, under the escort of Professor Hodgins, made a very pleasant journey to Mount Vernon, sixteen miles down the Potomac, which was reached by a forty-minute trip on the electric railroad, crossing the historic Long bridge over the river and running through the most quaint and interesting portions of Alexandria.

The Washington monument, which is next in height to the Eiffel tower, proved another attractive spot to many who found that the birds-eye view of Washington city and the surrounding country was well worth seeing, even by those who, instead of waiting for the elevator, chose to walk up and down the stairway.

During the afternoon, members of the party especially interested in telephony visited the new central station of the Chesapeake & Potomac Telephone Company, where General Manager F. H. Bethell gave them an opportunity to see the newest and best-equipped telephone exchange in the country. The transfer from the old central office to the new one was made by the company two days before the visit, and, so complete had been the preparations therefor, everything was working in the most admirable manner. The building, which is a handsome structure of white marble, six stories high, has just been completed at a cost of $225,000, and is exclusively for the business of the company. The three upper floors are given up to the operating department which is provided with facilities for convenient handling of the business of 6,000 subscribers which are now connected, with an ultimate capacity for a total of 18,000. The total num-

ber of subscribers in Washington is 13,000.

Other parties visited the government printing office, the Bureau of Printing and Engraving and the various power stations, the electrical appliances of which have been fully described in the REVIEW, while many of the English and Italian engineers went about the city to places of most interest to them.

The most unique and, in some respects, the most interesting exhibition seen in Washington was the collection in the National Museum arranged to illustrate the history of the beginning and development of the various electrical arts and industries. After the gentlemen who have been traveling on this "circular tour," and had been shown such marvelous examples of wonderful electrical achievements and had become so dazzled and dazed by the constant whirl of things that it was difficult to realize that these industries ever had a beginning, it was refreshing to see the simple, original pieces of apparatus which mark a great epoch in the civilization of the world and which form the foundation of the great electrical industries of the present. In the absence of Professor Langley, who is journeying in Japan, Mr. Richard Rathbun, the acting secretary of the Smithsonian Institution and director of the National Museum, arranged for grouping in the lecture hall of the institution some of the more interesting electrical objects where they could be conveniently and comfortably inspected by the visitors. The possibilities of electric traction were forcibly shown by Henry's reciprocating engine, of 1831; Davenport's motor, of 1837; Colton's motor; the first railway in which the track was used to carry the current, 1840; Farmer's electric train, which actually carried passengers in 1847, and Page's motor of 1850. Besides the machine of 1831, a case containing many other pieces of Henry's apparatus attracted much attention. Another case, devoted to the electromagnetic telegraph, contained Morse's first receiving machine, made by him in 1837, and which is, what Morse did not realize when he made it, a good Morse sounder, capable of being used on any telegraph line. The Seeley dynamo, deposited in the museum by the American Institute of Electrical Engineers, indicates the condition of the electric lighting business in 1857, while beside it stands Elihu Thomson's first arc light machine with a spherical armature, the first brush dynamo and one of the first lot of dynamos made by Edison, in 1878. In that year the Edison company made three dynamos of this type. One of them was used for several years in lighting a printing establishment in New York, the second one was placed on board the New York *Herald's* north pole discovery ship, the Jeanette, and is now somewhere at the bottom of the polar sea, and the one now in the National Museum was used on the Pacific passenger steamship Columbia for many years. The development of the speaking telephone is illustrated by a large number of Alexander Graham Bell's instruments, beginning with his crude apparatus of 1876 and running down to the latest and most modern instruments. Bell's photophone with which, in 1880, he transmitted articulate speech a distance of nearly half a mile by a beam of light; Farmer's electrical broiler, which he used in 1850 in cooking beefsteak, and his device illustrating his plan for using wind-power for operating electrical generators and charging storage batteries to be utilized in running incandescent lamps were regarded with curiosity and wonder.

A chapter in the history of submarine cables was made up of the geographical globe used by Cyrus W. Field and his associates in selecting a route across the Atlantic ocean; the pennant carried on the United States frigate Niagara and on the steamer Great Eastern while those vessels were engaged in laying the cables in 1856 and 1858, a section of the first cable cut out near the New Foundland shore by DeSauty when the original cable was replaced by a larger shore end, and many other relics of the enterprise.

The visitors spent considerable time in examining, not only the exhibits in the electrical department, but the extensive collections in the other departments of the institution.

By six o'clock in the afternoon the various groups of travelers began arriving at their hotel where supper was served at half-past six, and at eight o'clock the entire party left for Philadelphia.

Electrification of the New York, New Haven & Hartford.

The New York, New Haven & Hartford Railroad Company will expend eight million dollars in rebuilding its lines in the Bronx. The Harlem River and Port Chester lines will be remodeled into a six-track road, four tracks of which will be used for electric trains. Of these two will be used for express service. This line will extend from New Rochelle to the Harlem river station of the road and will be a little more than twelve miles in length.

A Waif at the Works of the Okonite Company.

On Tuesday, September 15, a 300-pound bale of cotton was received as part of a large shipment at the Okonite Company's mill, Passaic, N. J. This had been received from a cotton mill in Worcester, Mass., and had been en route some eight or ten days. The employés of the storeyard and mill, where the cotton had been deposited for some time, were mystified by hearing a series of strange noises, the source of which could not be located. Late on the Thursday afternoon following, so the story goes, one of the mill employés happened to pass through the storage room and heard a faint calling as if from a feline in distress. He was unsuccessful in locating the source of the cries. Mr. Whittier, the superintendent of the mill, walking through the storage room and investigating the matter, finally located the cries as coming from a bale of cotton placed in one of the corners of the room. Upon opening up this bale and spreading its contents on the floor, a very much emaciated cat was discovered securely packed in the cotton. It was barely alive, but through the heroic efforts of the officers and members of the Okonite Company it was revived, and is now a fixture in the Passaic offices of the company. The Okonite Company has gone on record in various ways, but this is the first time, it is believed, that it has posed as a nursery for half-dead felines. Upon investigating the matter, the mill authorities from whom the cotton was shipped could afford no better explanation than that the cat had been placed in the cotton to keep the rats away.

The New Telephone System at Hopkinsville, Ky.

In the issue of the ELECTRICAL REVIEW for September 17, on page 444, an article, entitled "The New Telephone System of Hopkinsville, Ky.," details the equipment of this modern exchange. It was stated in this article that the Automatic Electric Company, Chicago, Ill., was furnishing the telephones for this exchange. This, however, falls short of describing the work that this company is doing in connection with this installation. We are informed that the Automatic Electric Company is installing the entire equipment, including switchboards, telephones and all central station apparatus. The outside work, lines, poles, etc., are being installed by the Ideal Construction Company, of Lima, Ohio.

The Fall Meeting of the American Institute of Electrical Engineers.

The next regular meeting of the American Institute of Electrical Engineers will be held at the Chemists' Club, 108 West Fifty-fifth street, New York city, October 28, 1904.

Reviews of Current Engineering and Scientific Literature.

Some Recent Long-Distance Submarine Telephone Cables.

This article by Mr. F. Breisig discusses results obtained on new German submarine telephone cables. The submarine telephone cable from Fehmarn to Lolland is a connecting link in the Berlin-Copenhagen telephone line. It has a length of twelve statute miles, and was ordered conjointly by German and Danish telegraph authorities. Subsequently the cables between Greetsiel and Borkum, 18.3 miles, and between Cuxhaven and Heligoland, forty-five miles, were put down. These cables were made and laid by Messrs. Felten & Guillaume. The construction of the various cables is given, and also the mathematical determination of the line characteristics. If the self-induction is very large, the damping is practically the same for any frequency, and the speech transmitted over such lines will be clear, but weak. If, on the other hand, self-induction of the cable be zero, then the waves of high-frequency will be much weakened, and telephonic communications will sound loud, but dull and toneless. In the tests carried out on these cables, no law connecting the capacity with the frequency was discernible from the measurements made. It is not possible to decide from the few measurements taken whether the decrease in capacity with alternating currents actually ameliorates the cable with regard to its damping effect, or whether the advantage so gained is not counterbalanced by losses in the dielectric. By reason of magnetization and eddy current losses, the self-induction of the cable decreases somewhat with increasing frequencies. Since the increase in self-induction does not keep step with the increase of the diameter of the iron-covered conductor, the limits obtainable in practice are soon reached, and any further increase in the self-induction must be obtained by other means, such as those proposed by Pupin.—*Abstracted from the Electrician (London), September 2.*

The Use of Storage Batteries in Long-Distance Railway Work.

That storage batteries are not suitable for operating heavy trains over long distances seems to be the generally accepted opinion of railway engineers, since this application of storage batteries now receives practically no attention. While this attitude may be justified as regards the batteries of the past, it is not yet proved, according to Mr. W. N. Stewart, that the battery of the present may not have a wide field of usefulness before it in railway work. In the past, lead batteries have been used almost exclusively for the operation of single cars on tramway lines, and used without any assistance from an auxiliary line supply, or without the benefit to be derived from any of the regenerative systems now coming into use. So used, it is not surprising that failure has invariably resulted, and a like result would probably follow the use of a greatly improved battery if existing methods of operation only should be employed. If long-distance work with heavy trains were undertaken, instead of single-car operation, power would be used at a lower rate, thus saving two-thirds of the cost of batteries and a like amount in extra weight carried for equivalent work. If stops are required as often as once in four miles, the weight and cost of batteries would be reduced by one-half. A still further advance in the use of batteries may be made if they are employed in connection with a well-designed regenerative system. Regenerative systems have demonstrated their value on busy roads, but regenerative working on long lines with few trains would have but a limited utility, unless batteries were used. An estimate is then made of operating a line by means of a single-phase system only, and by means of a single-phase system aided by storage batteries. For the single-phase system alone, the mean load on the trains was taken as 6,000 kilowatts. The losses of the system in generation, transmission and transformation are 2,400 kilowatts, making a total capacity of the generating plant of 8,400 kilowatts. When using the comcombined system, a generating plant of 2,400 kilowatts is thought to be sufficient. The line and generating losses are taken as 960 kilowatts, bringing the total generating plant up to 3,360 kilowatts. In this system, each train carries a battery giving 660 kilowatt-hours, and having a maximum discharge rate of 540 kilowatts, worked on the regenerative system. The effect of the battery is to reduce greatly the size of the generating plant and the losses in distribution and transformation. The net cost of the battery system, including every requisite, is taken to be about $2,500 less per mile of single track than the cost of a purely single-phase system. Further, in the battery system each train will be self-contained and able to propel itself to a station or its destination in case of a breakdown of the generating plant, or the transmission system. On suburban lines, such as those about London, it is estimated that the battery system would save over $10,000 per mile, as the saving in third-rail construction alone would more than pay for the batteries. The author believes that in such a system the Edison battery would be successful, because from experiments made in Italy it was found that, excluding the cost of battery renewals, it was cheaper to operate trains by means of storage batteries than by steam locomotives; and one of the claims made for the Edison cell is that it does not depreciate.—*Abstracted from the Electrical Review (London), September 9.*

Refuse Destructors at the Saltley, England, Power Station.

Not infrequently refuse destructors are installed in connection with electrical power stations in England. The installation at Saltley, in that country, was described recently in a paper before the Association of Municipal and County Engineers by Mr. D. J. Roberts, an abstract of which is given here. There is nothing particularly novel about the electrical equipment, but the installation of destructor cells is interesting. There will be eight of these, arranged in two distinct sets, consisting of four cells; each set is supplied with one air-heater, a fan, and one settling chamber, twenty-four by four by ten feet, connected to one boiler, and forms one unit of the plant. The cells and settling chamber will be entirely lined with nine inches of firebrick, and covered externally with a wall of common hard brick fourteen inches thick. Between the outer and inner walls of brickwork will be an air space one and one-half inches wide, which will be filled with mineral wool. The two walls are braced together by double channel beams. The cells weigh about 4,500 pounds each. They are fitted with regulating valves to adjust the admission of heated air both above and below the grates. The hot air will be conveyed from the heaters to the cells below the floor in brick ducts thirty inches wide and twenty-four inches deep.

The clinkering doors will be lined with firebrick and arranged to slide upward. There will be two refuse hoppers, one over each set of cells, each measuring thirty-two feet long, thirteen feet wide and six feet deep. These hoppers do not touch the top of the cells, thus avoiding heating of the refuse. The doors to the cells are water-sealed, and are operated by means of small hydraulic rams. The air heaters consist of three-inch boiler tubes fixed in a vertical position, and secured at their upper and lower extremities to horizontal plates. These are entirely surrounded with brickwork, and the hot gases pass through them on the way to the economizer in the chimney. The air carried to the cells circles around the tubes, and thus is heated. It is said that this enables the initial temperature of the cells to be from 300 to 350 degrees. The use of forced air makes it easy to regulate the supply of air to the cells. These cells, with the two boilers, will evaporate not less than 9,000 tons of water when the furnaces are fed at the rate of 8,000 tons of refuse per hour.—*Abstracted from the Electrical Engineer (London), September 9.*

Experiments on Sheath Losses of Three-Core Cables.

An ingenious method of determining experimentally the losses which occur in the lead sheath of a three-core cable conveying polyphase currents is here described by Mr. J. T. Morris. Since these losses are due to a rotating magnetic field, a torque is set up by the action of this field on the currents produced in the lead sheathing. Part of the insulation lying between the cores and the lead sheath of a short piece of cable was removed. The cores were fixed in a vertical position, and the sheath suspended around them so as to be free to move. Measuring the torque tending to revolve the sheath, and knowing the angular velocity of the magnetic field, the sheath losses are equal to their product. The advantage of this method over the wattmeter method is that it uses the whole power of the losses to measure the loss, which hence may be done with much accuracy. In these experiments three cores were short-circuited at their upper terminals, an arrangement which removed any error due to a dielectric loss caused by unequal potentials of the cores. To determine the dependence of loss on the length of cable, sections of different length were employed. In all cases stout copper rings were carefully soldered to the two ends of the sheathing so as to allow the currents in the sheath to follow approximately the same paths that they would take in a long cable. The loss due to the copper rings was, in every case, corrected for. The experiments show that when using the copper rings the losses are practically proportional to the length of the sheath down to pieces as short as four inches. Without the rings, pieces as long as two feet would be necessary for giving correct results. The experiments show that the loss in the dead sheath is rigidly proportional to the square of the current strength and the square of the frequency. By turning down different pieces of thick lead sheathing so as to obtain different thicknesses, it was found that the loss varies as the thickness raised to the 0.7th power. Placing a three-inch wrought-iron pipe outside the lead sheath increased the lead loss by seventy to seventy-five per cent through the whole range of current for which tests were made. The losses in the iron pipe were not measured, but this could easily be done by the same method. In conclusion, the author gives the following formula for determining the loss in watts taking place in a lead sheath: watts lost $= c^2 f^2 l t^{0.7} \times 37 \times 10^{-12}$, where c is the current in amperes; f, the frequency; l, the length of cable in yards; t, the thickness of the sheath in mils. This gives a loss of 17.3 watts per mile at a current of fifty amperes per phase, and a frequency of sixty cycles. The cable in this case was a high-tension three-core cable suitable for a current of fifty amperes per phase. The thickness of the insulation between each conductor was 0.35 inch; the resistance per mile of each core was 0.71 ohm; the lead sheath was about an eighth of an inch thick, and the outside diameter of the cable nearly an inch and seven-eighths. The total copper loss per mile of this cable carrying the same current is 5,340 watts, so that the sheath loss is only one-third per cent of the copper loss. It produces no greater effect than the increase in copper loss brought about by a rise of one degree centigrade in the cable.—*Abstracted from the Electrician (London), September 2.*

Central Stations for Distributing Electrical Energy in France.

In this introduction to the tenth report of the electric-generating stations in France, M. A. Soulier points out the general direction of French development. The report shows the condition at the first of last January, and demonstrates that the development of central stations in France has increased regularly. One thing is noticeable in this report. Previously each village possessed its own central station, whether for alternating or for direct currents. Now these smaller systems are grouped together and supplied from one central station of large output, utilizing generally a waterfall or coal burned at the mine. Operation under these conditions is very economical, and the exploitation very regular. It has resulted in a reduction in the price of energy. To-day the market towns are lighted electrically instead of by oil as formerly. The electric motor is being used more freely, on account of its lightness, small depreciation and the ease of putting it into operation. Its use is effecting important economies in such cities as Lyons, Saint-Étienne and Grenoble, where it is used in the weaving-mills. It is even being used on the modern farm, where it has replaced the old-fashioned traction engine. The exploiting companies, as well as the public, reap advantage from these developments, for they improve the load-factor of the station, and by means of suitable rates still further increase the output of the station to the best advantage. Among the large distributing systems, that having the greatest extent is the Société Meridionale d'Électricité, which has a total development in Lyons of nearly 600 kilometres. This system covers the department of the Aude entirely, and some of its ramifications penetrate into neighboring departments. The energy of the system is transmitted from the station at St. Georges by means of three-phase alternating currents at 20,000 volts. The region around Grenoble is another important locality where water powers have been well developed. Here the general practice of the Société Meridionale has been adopted, but the voltages vary from 25,000 to 36,000. Another important section is that of the Mediterranean coast, a favorite winter resort. This is fed by many alternating-current lines at high tension. There has also been a gradual development of small stations in France. Attention is called to the fact that distributing systems using 220-volt lamps have not developed as much as had been expected. This is attributed to the fact that the use of the 220-volt lamp is not very common as yet, and also to the general employment of alternating currents, which are easily transformed. The voltage of distribution generally prevailing is 110. Practice in frequency has narrowed down to fifty cycles per second. The tables of statistics are apparently very complete, including the population served, the character of the plant and distributing system, and the work done.—*Translated and abstracted from L'Industrie Électrique (Paris), September 10.*

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Heany Enclosed Arc Lamp.

The inventor of the Heany enclosed arc lamp, manufactured by the American Electrical Manufacturing Company, Philadelphia, Pa., has recently been awarded the John Scott legacy premium and medal by the Franklin Institute, Philadelphia. The most novel feature of the lamp is a combined electromagnetic core and clutch for regulating the feed of the upper or movable carbon. In addition the lamp has a simplified method of construction in a movable solenoid coil for readily changing the amperage without changing the regulating resistance and a dashpot connected with the core clutch

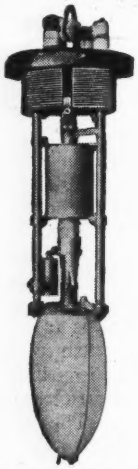


FIG. 1.—LAMP WITH CASING REMOVED.

to prevent sudden movements or chattering of the upper carbon. The construction of the lamp upon three tubular rods, parallel and equidistant, is shown in Fig. 1.

At the upper ends these pass through and are fastened to the porcelain core of the resistance coil of "Climax" resistance wire; a slot up one side of the core admits an adjustable clip which may be fastened to any one of the seven lower turns of wire, so as to cut out up to that much of the resistance. About two inches below this is the small solenoid coil of asbestos covered wire, whose flanges each have three projecting lugs through which the rods pass free, so that the entire solenoid may be moved up or down on the rods and held in any desired position by split collars on the rods placed against the outside of the flanges and held tight by set screws. From the top of the lamp to the globe seat, and with the same axis as the resistance and solenoid coil, extends a fixed tube which encloses a flexible conductor and a movable holder for the upper carbon. Around this fixed tube, and guided by a slot to move up or down it, is the combined solenoid core and magnetic clutch shown in Fig. 2. This consists of semi-tubular parts, hinged together so that the two jaws at

FIG. 2.—MAGNETIC CLUTCH.

the lower non-magnetic ends will clutch the upper carbon and lift it when the current through the solenoid coil becomes strong enough to magnetize with like polarity, and hence to repel the two upper ends of the semi-tubular parts, and to draw them into the solenoid. When the magnetic pull weakens, the core falls into the tapered support for the inner tube, which acts as a spreading device for the clutch and allows the upper carbon to feed down. A pneumatic dashpot, whose piston is connected to the magnetic clutch, prevents any sudden movements or jumping of the upper carbon. This dashpot is also adjustably carried on one of the tubular rods. From the seat for the enclosing globe extends downward the single arm that carries the lower carbon, the latter passing through a hole in its lower end and being firmly clamped by a little cam.

The construction of the lamp is exceedingly compact and light, and yet appears to be durable and mechanically good. In the 110-volt lamp, the arc voltage can readily be varied from about sixty to eighty volts by moving up the clip on the resistance coil. A unique feature is the ready means of adjusting the length of the arc and the current consumption from about four to six amperes, by moving the solenoid up or down on the tubular rods, a movement of one-eighth of an inch, causing a change of about half an ampere. The magnetic clutch appears to be a new feature for enclosed arc lamps and in conjunction with the dashpot operates very effectively in the immediate establishment and then constant maintenance of a steady and brilliant arc. In tests made by the Franklin Institute, two 110-volt, five-ampere lamps averaged 127 hours of continuous burning with seven-sixteenths-inch carbons, while a third lamp with one-half-inch carbons ran for 162 hours. A lamp was short-circuited for one hour with a current averaging fifteen amperes, and though the resistance wire and solenoid were heated cherry red and the adjacent metallic parts were tarnished,

FIG. 3.—LAMP ENCLOSED IN CASING.

there was no permanent injury to the construction or subsequent operation of the lamp.

Tests with Magnetic Adhesion.

In Kansas City recently the Kansas City Railway and Light Company made a series of tests with the magnetic adhesion device of the Magnetic Equipment Company. Under the most unfavorable conditions with the use of this apparatus an increase in traction of twenty-two per cent was obtained. Under better conditions the increase was higher.

Trolley Lunch Room.

The Transit Company, of St. Louis, has been obliged to face a number of difficulties in connection with the heavy traffic and unusual demand of the exposition public. Car crews had difficulty in getting lunches, very often having to eat them during trips. A lunch room in a car has overcome most of the trouble and proved a great success.

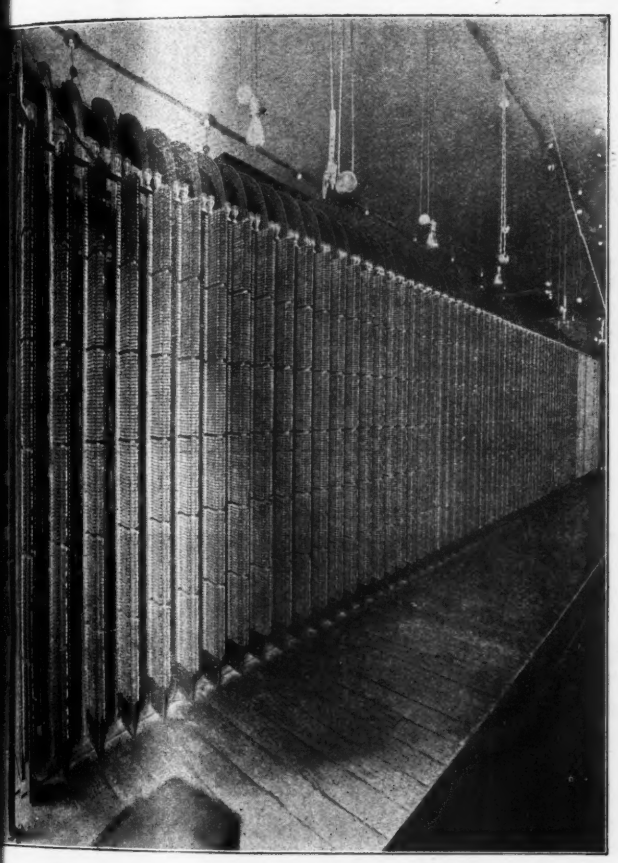
A Modern Protector and Distributing Board.

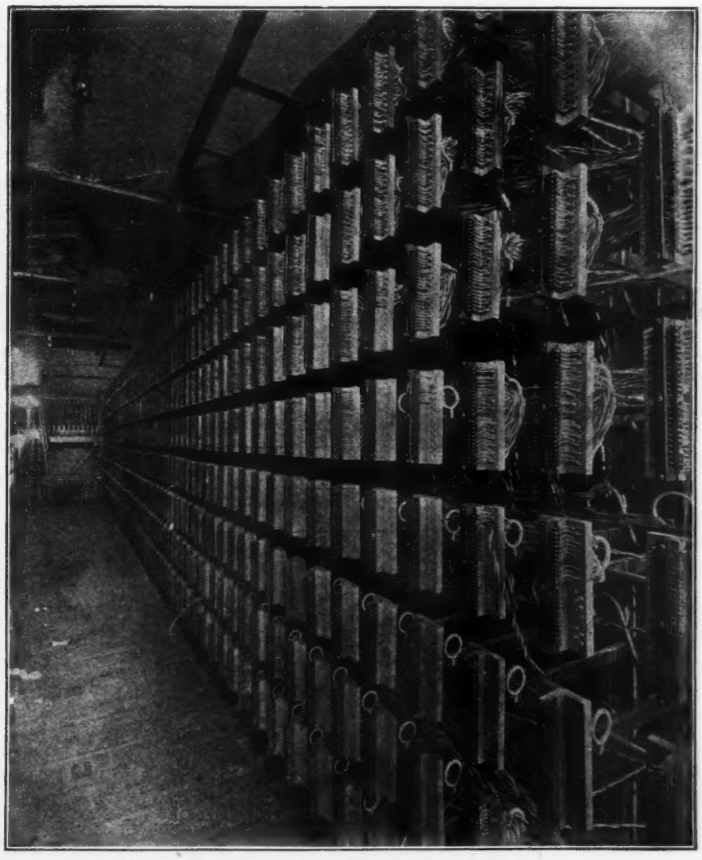
One of the largest single protector and distributing boards ever installed is that furnished by Frank B. Cook to the Illinois Telephone and Telegraph Company for its main exchange in Chicago. This distributing board has a switchboard capacity of 10,100 pairs, and a line capacity of 12,500 pairs. The framework of the board is constructed of the usual angle irons and channel irons, and is capable of extension at any time by simply bolting new sections of the frame to that already installed. Wherever the circuit conductors (the jumper wires) would lie against an iron portion of the frame, an enameled ring is provided, through which the conductors extend and are thereby kept out of close proximity with the ironwork of the frame.

The switchboard side of the frame is equipped with Cook's No. 44 protectors, which are mounted in banks of twenty-five pairs each, on vertical steel bars three-eighths inch by four inches. Each vertical contains six of these twenty-five-pair banks, or 150 pairs. The springs of each pair of the protective apparatus are arranged and adapted to receive a testing plug which permits all of the different circuits through the apparatus, including the switchboard circuit, the line circuit through the heat coils, the line circuit direct, or either heat coil separately, to be tested independently of each other and without the necessity of removing the heat coils or lightning arresters from the apparatus, with but one insertion of the plug.

Instead of wiring the alarm circuit for all of the pairs of protectors to a common alarm bell or indicator, each side of each vertical of the protective apparatus is wired to a lamp signal which is mounted directly on top of the vertical, always in plain view. When a heat coil operates, it closes the alarm circuit of one side of the vertical in which it is situated, and thereby causes the corresponding lamp to light and give a signal that a protective device has operated. The signal lamp stays lighted until the protective apparatus is restored to its normal position. In addition to a signal lamp for each side of each vertical strip of protectors, there is a large gong or signaling device wired common to all the signal lamps, to give a general signal when a protector or any part of the board operates. This general signal calls the attendant's attention to the fact that a protective device has operated, in case he is not at a place from which the signal lamp can be seen. With this arrangement of the protective apparatus and signal lamps, the matter of locating trouble is a very simple one.

The distributing terminals for the line side of the distributing frame are mounted in hard rubber strips on maple blocks, there being twenty-five pairs of terminals on each block and eight blocks mounted one above the other, to form a vertical of 200 pairs of terminals.





PROTECTOR AND DISTRIBUTING BOARD. CAPACITY SWITCHBOARD, 10,100 PAIRS; LINE, 12,500 PAIRS.

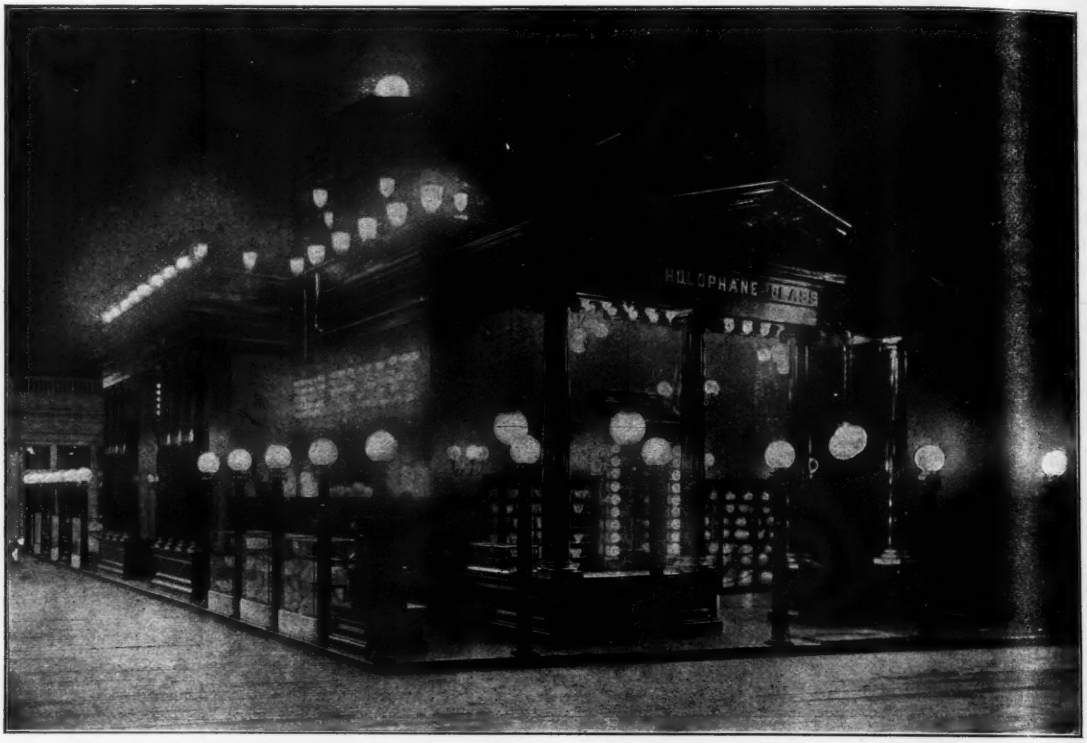
The frame is very compact, and the cabling shows the results of neat and skilful workmanship.

This distributing frame was manufactured and also installed by Frank B. Cook, the installation being a point worthy of note, as it is not customary for manufacturers of this class of apparatus to superintend its installation.

The complete distributing frame has been in service for some time, and is at the present time carrying and protecting several thousand working lines. This has given the apparatus a good test, and under such usage the frame and protective apparatus have been entirely satisfactory. This information is furnished through the courtesy of Frank W. Pardee, Chicago, Ill.

Holophane Glass Globes at the World's Fair.

The accompanying illustrations show the exterior and interior views of the exhibit of the Holophane Glass Company, space 25, Electricity Building. The disposition of the lighting effects is well shown in the reproduction of the interior view, giving a natural comparison of the illumination with Holophane glass globes and with ordinary glass globes. On the left of the illustration is that portion of the interior illuminated by Holophane globes; upon the right is that portion illuminated by ordinary glass globes. In each compartment there are the same number of lights used and the same amount of current is expended.



EXTERIOR VIEW OF THE EXHIBIT OF THE HOLOPHANE GLASS COMPANY, ELECTRICITY BUILDING, WORLD'S FAIR, ST. LOUIS, MO.

INTERIOR VIEW OF THE EXHIBIT OF THE HOLOPHANE GLASS COMPANY, ELECTRICITY BUILDING, WORLD'S FAIR, ST. LOUIS, MO.

The two portions of the interior are divided by a curtain of such material that there is no transmission of light from one division to the other.

Holophane optical glass globes are the invention of the well-known scientists Blondel and Psaroudaki, of Paris, France. By their system of calculation light is softened and diffused not only without waste, but with an increase of its illuminating efficiency. The rays of light are broken up by scientific prisms and scattered or diffused so that, while retaining their full efficiency, the rays are softened and rendered harmless and agreeable to the eyes.

Holophane globes are made in three different classes, each class distributing the maximum amount of light rays within different angles. By making these globes of different sizes and shapes and of different classes of light distribution, the Holophane company is able to meet all the varying requirements of artificial illumination. Tests made by the General Electric Company, the Welsbach Company and other large lighting companies have proved that Holophane globes and reflectors possess the highest total illuminating efficiency. It is stated that hundreds of thousands of Holophane globes and reflectors are used by these companies every year. In addition to the companies just mentioned, the Bryan-Marsh Company, the Columbia Incandescent Lamp Company, the Western Electric Company, the Buckeye Electric Company, the Fostoria Incandescent Lamp Company, the Shelby Electric Company, the Sunbeam Incandescent Lamp Company, of Canada, Limited, the Independent Incandescent Lamp Company, the Warren Electric and Specialty Company, the Colonial Electric Company, the New York & Ohio Company and many others make use of large numbers of these globes and reflectors.

We are also informed that the Allgemeine Electricitäts Gesellschaft, of Germany, has agreed to become the sole selling agent in Germany for the scientific glass globes and reflectors manufactured by the Holophane Glass Company.

The John Scott medal, given each year by the Franklin Institute, of Philadelphia, to the most improved and meritorious invention in the world, was, in 1898, awarded to the Holophane system of scientific globes.

The Holophane Glass Company, 15 East Thirty-second street, New York city, is the sole manufacturer of these globes. The V. R. Lansingh Company, 211 Jackson Boulevard, Chicago, Ill., is the western distributor.

The Exhibit of G. M. Gest at the World's Fair.

The exhibit of G. M. Gest, subway contractor, of New York and Cincinnati, which is in the court of the Electricity Building at the World's Fair, shows a high and low-tension manhole complete in every detail, including cast-iron casting, Gest's patented cable hanger, also his patented conduit terminal, sewer trap and burlap coating machine, all novel and new, which go to make up a perfect conduit system. The manhole is shown exactly as a manhole built in the ground with the front side removed. A dummy cable splicer in shown in one apartment of the manhole and a tile layer is shown outside in a trench laying conduit. It is the most complete and comprehensive exhibit of its kind ever shown and is attracting a world of attention.

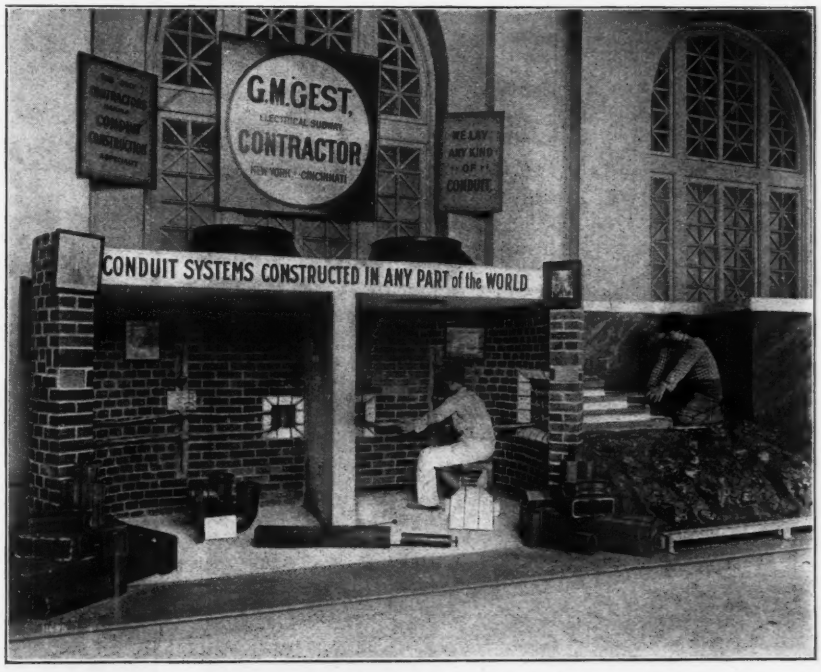


EXHIBIT OF G. M. GEST AT THE WORLD'S FAIR, ST. LOUIS.

Mr. Gest's representative, Mr. W. T. Jackson, has been at the exhibit for some time and special attention was shown the members of the International Electrical Congress at the meeting in St. Louis. The foreign engineers especially took great interest in the various devices shown by Mr. Jackson.

Tests of a Reeves Simple Engine.

In tests of a Reeves simple engine, made by Professor R. C. Carpenter and Professor Diederichs, of Sibley College, Cornell University, Ithaca, N. Y., some remarkable results were obtained. The pounds of dry steam for indicated horse-power per hour were found to decrease steadily from a friction load until it reached its minimum at about twenty-six pounds of dry steam at about 130 indicated horse-power for the condensing runs, and about twenty-eight pounds at the same load for the non-condensing series. With a higher load there is a small increase in the steam consumption, giving about 27.5 pounds at 176.3 indicated horse-power condensing, and about 31.3 pounds for 159.2 indicated horse-power non-condensing. The remarkable feature in these results is the nearly constant steam consumption of this engine on the indicated horse-power when running condensing. At eighty indicated horse-power this is about 27.2 pounds; it drops to about twenty-six pounds at 130 indicated horse-power and rises again to 27.5 at 176.3 indicated horse-power, giving a nearly constant range of from forty per cent underload to about forty per cent overload. In dry steam consumption per developed horse-power, the best consumption is about twenty-seven pounds at 130 developed horse-power condensing, and about 31.9 at 130 developed horse-power non-condensing. The relation between the mechanical efficiency and the developed horse-power is very good. The highest efficiency reached, non-condensing, is 92.5 per cent at 147.1 developed horse-power and 159.2 indicated horse-power. For the condensing series the results are still better. The best figure is 95.8 at 154.1 developed horse-power, and 165 indicated horse-power, but the mechanical efficiency already reaches ninety per cent at seventy-eight horse-power, ninety-five per cent at 133 developed horse-power and remains nearly constant from there up to the highest load, 168.2 developed horse-power.

The Exhibit of the H. W. Johns-Manville Company at St. Louis.

The accompanying illustration shows the exhibit of the Sachs "Noark" enclosed fuses and fuse devices made by the H. W. Johns-Manville Company, New York city, in the Electrical Building, St. Louis Exposition.

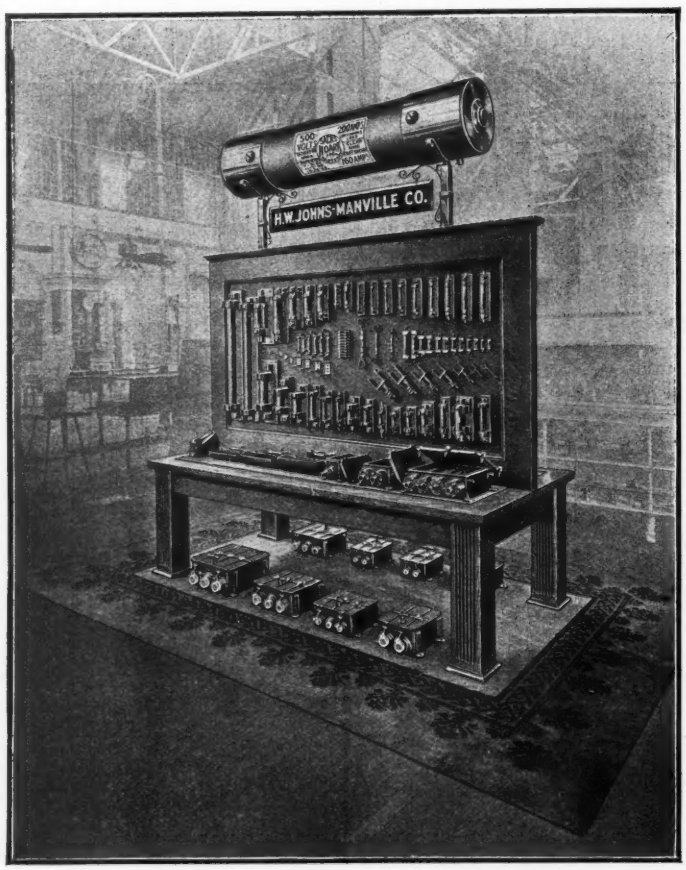
Although the exhibit is not large, it is thoroughly representative and shows the various enclosed fuse devices of different types and styles manufactured by this company. The fuses are mounted on a large display board rising from the centre of an oak table. Over all there is suspended a large enclosed fuse, duplicating the actual device in every particular. On both sides of the display board there are mounted different styles of fuse blocks equipped with their respective fuses. One side of the board is covered with 220-volt devices, the other side presenting the higher-potential appliances. The display of blocks and fuses is very comprehensive, including every standard block and fuse manufactured by the company.

Upon the table, on each side of the display board, and also on the floor underneath the table, is a complete line of fuse and service boxes with the now well-known lobster-claw fuse-clamping arrangement. There is also a line of car equipment fuse boxes, subway boxes, etc.

The exhibit includes a testing box containing an open fuse block and a Sachs "Noark" enclosed fuse block. Demonstrations are given of the comparative effects of blowing an open and an enclosed fuse.

The Sachs "Noark" enclosed fuse is the invention of Mr. Joseph Sachs, and for this the inventor has been awarded the John Scott legacy medal and premium by the Franklin Institute of Arts and Sciences. These devices are manufactured by the Johns-Pratt Company, Hartford, Ct., for whom the H. W. Johns-Manville Company is the exclusive selling agent.

Credit for the attractive appearance of this display is due to Mr. G. D. Pogue, of the electrical department of the St. Louis branch of the H. W. Johns-Manville Company, who has full charge of the exhibit.



THE EXHIBIT OF THE H. W. JOHNS-MANVILLE COMPANY, ELECTRICITY BUILDING, WORLD'S FAIR, ST. LOUIS.

Recent Tests of Steam Engines.

The results of tests made in April and June of this year at the Poplar Vestry (London) Electricity Works are given in the *Mechanical Engineer* (London) for September 10. These tests were carried out on a 500-kilowatt Willans engine, with a view of ascertaining the commercial efficiency of this engine when driving a Mather-Platt generator under working conditions. They show the results obtainable with this type of engine, working with only a moderate amount of superheat and a comparatively poor vacuum, at full load. With a vacuum of twenty-five inches in the engine and twenty-five degrees of superheat only the total steam consumption was 18.64 pounds per kilowatt-hour in one case, and 19.52 pounds on a second trial, the mean of the two trials being about nineteen pounds of steam per kilowatt-hour, corresponding to eleven and one-half pounds per indicated horse-power-hour. At three-fourths load the corresponding figures were 20.72 pounds per kilowatt-hour and 12.1 pounds per horse-power-hour. At one-half load the consumption rose to 22.62 pounds and 12.46 pounds, respectively. Similar tests carried out at the Blackburn Corporation Electricity Works on a 750-kilowatt Willans steam engine driving a Dick, Kerr & Company continuous-current dynamo gave a steam consumption of 18.34 pounds per kilowatt-hour, corresponding to 11.05 pounds per horse-power-hour at full load. During this test the vacuum was twenty-two inches and the degrees of superheat, 112 Fahrenheit.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

TO TEST A MONORAIL SYSTEM—It is announced that a number of New York business men will form a company called the American Monorail Company of New York, to purchase the patents of E. L. Tunis, of Baltimore, Md. A five-mile track and trolley poles of a monorail system is to be built between Baltimore and a point near the Patapsco river within the next two months.

ELECTRICITY FOR MADRAS, INDIA—Advices from British India state that a Calcutta firm has applied to the government of Madras for a franchise to supply electrical energy throughout the municipal area of Madras. It is proposed to construct a generating station or stations and to supply electricity by underground mains or any other system approved by the local government.

NEW PENNSYLVANIA TROLLEY ROAD—The contract for the construction of an electric railroad between Scranton and Tunkhannock, Pa., has been awarded to the American Limestone and Cement Company, composed largely of Columbia County business men. The road is to be operated by the Scranton, Factoryville & Tunkhannock Electric Railroad, a corporation which has been chartered for about two years. The road will be about thirty miles long, and the cost of construction will be $950,000.

ADDITIONAL POWER FOR MONTREAL, CANADA—Announcement has been made that the Shawinigan Water and Power Company has completed arrangements by which it will be able to deliver 10,000 additional horse-power to Montreal, Canada, by December 1 next. This will entail the erection of an additional transmission line from Shawinigan to Montreal, and the installation of new apparatus at the substations. A new penstock is being erected from the bulkhead to the power-house at Shawinigan.

DENVER TELEPHONE COMPANY ASKS FOR HEAVY DAMAGES—The Denver (Col.) Telephone Company has brought suit against the Colorado Telephone Company, in which $1,800,000 damages are asked. Charges of fraud are made against the defendant, and it is alleged that the Colorado Telephone Company attempted, through illegal methods, to run all competition out of the local field. For this alleged fraud the plaintiff asks $1,000,000, and $800,000 is asked for actual loss of profits, which are estimated at $100,000 a year for eight years.

LARGE PLANT FOR THE PUBLIC SERVICE CORPORATION OF NEW JERSEY—It is announced that the Public Service Corporation of New Jersey will build a large combined gas and electric plant at Hackensack, N. J., near the western boundary of Jersey City. The gas plant will have a capacity of 50,000,000 cubic feet per day, and the electric plant will be one of the largest that has yet been built. The plant will cover one-half a square mile and have a frontage of 2,000 feet on the Hackensack river. It is expected that 100,000 piles, each forty-five feet long, will be driven into the marsh before the foundations are started. The building will have eight-foot foundations of mixed stone and cement.

NEW YORK SUPPLY DEALERS MEET—Forty or fifty men representing electrical supply houses of the North, South, East and West gathered at the Hotel Iroquois, Buffalo, on Friday and Saturday, September 23 and 24. Matters pertaining to the future welfare of the electrical jobbing trade were discussed and plans for the correction of several existing evils in this important branch of the electrical industry were taken under consideration. The meeting was a most harmonious one. As one man prominent in this field said, "these occasional meetings obviate many misunderstandings and give us increased respect for our competitors. This meeting especially should result in great good to us all individually and collectively." In addition to the representatives of electrical supply companies a number of manufacturing interests were in evidence during the meetings though none but supply dealers were present at the session.

TRACTION PLANS FOR NEW TUNNELS IN CHICAGO—Consulting Engineer George W. Jackson has submitted preliminary plans for lowering the street car tunnels in Chicago, Ill. These plans have been received by the committee on local transportation. They include alternate systems of down-town subways, so as to take cars off the surface. In the figures presented to the committee, the engineer gave the cost of lowering the tunnels and bringing the cars to the surface down-town as at present; of building one north and one west side subway system down-town to care for the cars now going through the tunnels; and of a double north side and single west side subway station. It is estimated that it would be cheaper to build new tunnels than to depress the present street railway systems.

NEW POWER COMPANY TO BUILD PLANT ON THE CONCHOS RIVER, MEXICO—The construction of a large hydroelectric plant on the Conchos river, Chihuahua, Mexico, will be commenced shortly by the Conchos River Power Company, incorporated under the laws of the state of New Jersey. John F. Kelly, of the Kelly Engineering Company, is president of the company. The work contemplated will be of great magnitude, involving the expenditure of $1,000,000. The power plant will be situated on the Conchos river, in the vicinity of the village of La Joya. Energy will be transmitted to Parral, forty-four miles distant, and to Chihuahua, eighty miles away. A series of reservoirs will be built, where the rainfall during the wet season can be caught and stored in case of a dry period of any considerable length.

LONG-DISTANCE SERVICE OF THE MARYLAND TELEPHONE COMPANY—During the past few months the Maryland Telephone Company has extended its long-distance lines so that they now reach about 2,500 cities and towns in Maryland, Delaware, Pennsylvania, Virginia, West Virginia and New Jersey. The subscribers to these lines number about 100,000. The company is completing the connection with Cumberland, Md., which will make possible communication with Pittsburg, Johnstown, Somerset, Erie and other towns of western Pennsylvania and towns and cities in western Ohio. The company hopes to give service to Illinois through independent companies operating in Ohio. The completion of the Cumberland connection will add 2,000 cities and towns to the system, embracing about 120,000 additional subscribers.

MEXICAN ELECTRICAL NOTES—It is announced that an American syndicate has applied for a concession to construct an electric railway system in Guadalajara, and has offered to pay into the state treasury $400,000 in eight annual instalments of $50,000 each for the franchise. In the event of this offer being accepted by the government, an arch will be built over the San Juan river, which flows through the eastern part of the city. The transmission line which the Guanajuato Power and Electric Company is building from Mexico to Leon is about one-third completed. The company is now supplying about one-half of its actual capacity of 64,000 horse-power. Although the plant was placed in operation only about a year ago, it is doing an excellent business, and it is estimated that by the end of the year its receipts from the sale of power will be sufficient to pay all fixed charges, including operating expenses and interest on bonds. A concession has been obtained from the Mexican government to construct the necessary works for the utilization of 10,000 litres of water per second from the Baluarte river, or from the Rosaria river, in the district of Rosaria, state of Sinoloa. The survey for the localization of the works must be commenced within six months from September 9. Within twelve months from the same date the plans must be submitted in duplicate to the state department. Within the following twelve months construction of the works must be commenced, and the whole plant must be finished and in operation within the next following five years.

TELEPHONE AND TELEGRAPH.

PENTWATER, MICH.—An automatic telephone system has been placed in operation. The plant cost $3,000.

JACKSONVILLE, FLA.—All the property of the Jacksonville Telephone Company has been sold for $5,000 to D. T. Gerow, supposed to represent the principal creditors.

BRANTFORD, CANADA—A special committee of the Brantford city council decided to recommend the construction of a municipal telephone system, at an estimated cost of $37,000.

EATONTON, GA.—The Southern Bell Telephone Company has installed its system, giving the town connection with Milledgeville, Macon, Augusta, Savannah, Atlanta and intermediate points.

SEATTLE, WASH.—The Pacific States Telephone Company states that construction will at once be begun on a line to Mohler, Ida. The line will extend from Fletcher, where several other extensions will be made.

SOUTH McALESTER, I. T.—The Schooler Brothers' Telephone Company will begin the construction of a new telephone system in South McAlester in the near future. The system will cost $50,000 and will be underground.

OKOLONA, LA.—The Cumberland Telephone Company has bought out the local companies in Chickasaw County, and will install its own service all over the county, with exchanges in Okolona and Houston.

CONNELLSVILLE, PA.—The Tristate Telephone Company has let a number of contracts for extending its service throughout the county. The principal one of these was for extending the line to Brownsville by a private right of way.

KENTON, OHIO—Owing to the increase of toll business the Kenton Telephone Company will install a new two-position toll board. New copper toll circuits have been strung between Kenton and Columbus and Kenton and Bowling Green.

EUSTIS, FLA.—A telephone company has been incorporated with a capital of $2,500. The company will construct and maintain a line from Eustis to such other towns as may be necessary. H. G. Whitsett, Henry W. Bishop, Charles H. Newall, W. B. Merck and F. A. Hall are the incorporators.

MEADVILLE, N. Y.—The Meadville Telephone Company has closed a contract for a line between Meadville and Cochranton. When this line is completed it will give the company a through copper circuit to Pittsburg, and will also give it direct connection with Franklin, Oil City and Titusville. The contract calls for the completion of the line in sixty days.

HOUSTON, TEX.—The Southwestern Telephone Company has signed a contract for improvements to its present building that will cost $15,000. They will consist of remodeling and strengthening the building. The company has also ordered a switchboard of 10,000 capacity. It has now 4,400 subscribers here, and the increase has averaged 100 for the past six months.

ROMULUS, N. Y.—A county telephone line has been organized to be called the McDougal Telephone Company. At a meeting of the stockholders, Addison Baldridge was elected president; R. C. Allen, vice-president; Clarence C. Updike, secretary, and Alexander Baldridge, treasurer. Work is to be begun at once, and it is expected the new line will be in operation before winter.

MINDEN, NEB.—At a regular meeting of the city council the Kearney Construction Company was granted a franchise to install an independent telephone line here. The franchise calls for a rate of $1 per month in residences and $1.50 per month in business houses. All lines are to be metallic circuits and all telephones will have long-distance transmitters. The line is to be in operation in eight months.

SANTA FE, N. M.—Arrangements are now under way for the building of a telephone line from Artesia to Alamogordo, a distance of 100 miles. The connection of Artesia with Alamogordo would give Roswell long-distance connection with Santa Fe, Albuquerque, Las Vegas, Captain, Cloudcroft and all important mountain towns. The line would also connect with El Paso, Dallas, Fort Worth, Galveston and many other Texas towns.

ELECTRIC RAILWAYS.

SULPHUR, I. T.—The city council has granted a franchise to the Oklahoma City, Lexington & Sulphur Springs Electric Railway.

GREENSBORO, N. C.—The High Point Interurban Traction Company has been granted a franchise to operate over the public roads of the county.

SAN JOSE, CAL.—An electric railway will be in operation between San Jose and Palo Alto within a year. It will be built by the Interurban company.

WILKESBARRE, PA.—The Wilkesbarre & Wyoming Valley Traction Company is spending the sum of $300,000 in improvements, mainly upon its power-houses.

LAURE, OHIO—An engineering corps is surveying an electric line from Richwood to Kenton. The stockholders of the Magnetic Springs health resort are building the line.

ROCK ISLAND—The Kewanee city council has passed an ordinance giving the Galesburg & Kewanee Interurban Electric Railway Company a fifty-year franchise within the city limits.

MANHATTAN, KAN.—The Commercial Club will call a mass meeting of citizens to discuss the possibility of building an electric railroad here. Kansas City parties are backing the proposition.

FORT WORTH, TEX.—At a meeting of the city council of North Fort Worth the Northern Texas Traction Company was granted a franchise to lay tracks and operate an electric street car system.

CINCINNATI, OHIO—The Cincinnati & Columbus Traction Company has obtained a franchise for twenty-five years from the council of the village of Milford. This road is owned largely by Cincinnati capitalists.

WASHINGTON, N. J.—The Morris County freeholders have granted a franchise to the Morris County Traction Company to run a trolley line through Rockaway, Randolph and Roxbury townships to Wharton.

SPRINGFIELD, OHIO—Frank Patterson, of Brooklyn, is at the head of a company incorporated with a capital stock of $50,000, which will build an electric line from this city to Chillicothe, a distance of sixty-five miles.

WASHINGTON, IND.—The city council has granted to the Vincennes, Washington & Eastern Traction Company the right to run electric cars through certain streets. The line must be completed within sixteen months.

BUCYRUS, OHIO—An engineering corps is surveying the line of the Bucyrus & Marion Electric Railway, which will be built via Kirkpatrick and Tobias. From Tobias the road will parallel the Shore Line, a branch of the Pennsylvania.

CORNING, N. Y.—It is reported that a deal is on foot to construct the proposed electric railroad from Corning to Elmira. The new company which has abundant capital behind it will absorb the Corning & Painted Post Street Railway.

MANITOWOC, WIS.—Formal notice of the acceptance of the franchise passed by the city council, June 20, this year, has been filed by the Fond du Lac & Northeastern Electric Railway Company, which will build a line from Fond du Lac to this city.

LEXINGTON, KY.—Action has been entered here for a receiver for the Blue Grass Consolidated Traction Company, capitalized at $7,000,000 and managed by Senator George B. Davis, of Detroit. It has only partially completed its interurban system in central Kentucky.

NEW ORLEANS, LA.—A contract has been let to the General Electric Company for three 1,500-kilowatt Curtis turbines to be installed in the new power-house about to be constructed by the New Orleans Railway Company. The ultimate capacity of this plant will be 60,000 horse-power.

BALTIMORE, MD.—Work has begun on the proposed trolley railway from the Sassafras river to Fredericktown, Cecilton, Warwick and other points in lower Cecil County, on to Middletown, Del. The line will be ten miles in length and will do a freight as well as a passenger business.

DENVER, COL.—A new electric railway from Buena Vista to the mines at the head of Cottonwood gulch is contemplated by the Continental Gold Mining Company, articles for the incorporation

of which have been filed by W. W. Weaver, C. W. Weaver, Peter Savard, A. J. Smith and H. H. Roberts.

CLEVELAND, OHIO—The Lake Shore Electric Railway has begun the operation of its entire line with but two power-houses. Over 160 miles of line are operated. The power-houses are located at Fremont and at Avon Beach. The saving is considerable, as formerly the company had four stations.

KEWANEE, ILL.—Two interurban electric railway companies have started work here. The Kewanee, Cambridge & Geneseo line, to be thirty miles long, will connect the cities mentioned. The Galesburg & Kewanee Company will build a local system immediately, and later connect Gales and Kewanee.

CAMDEN, N. J.—The Burlington County Railway Company has announced its intention of extending its road so that Camden and Bordentown will be the terminals of the system. Maps have been filed with the clerk of Monmouth County, at Mount Holly, for a route extending from that place to Bordentown.

GRAND JUNCTION, COL.—The county commissioners have passed a resolution granting to George Smith or his assigns the right to use the highway for an electric line between this city and Palisades. As soon as the council gives the right of way into the city, Denver parties stand ready to construct the line.

OMAHA, NEB.—It is expected by the street railway company that its new power-house will be in full operation by January 1. A portion of it will be in use, it is expected, prior to that time. With the new power-house in use, the old one will be abandoned as a power-house, but will be turned into a repair and car rebuilding shop.

DETROIT, MICH.—The Lansing City Electric Railway and the Lansing, St. Johns & St. Louis Railway have been merged. The new company, which is known as the Lansing & Suburban Traction Company, has authorized a bond issue of $750,000 to take up the bonds of the underlying companies and provide for further extensions.

MILWAUKEE, WIS.—John M. Saeman, of Plymouth, says he has signed contracts with a Pittsburg firm to build and equip a power-house at Elkhart Lake to operate an interurban line between Plymouth and Chilton. Mr. Saeman expects to run cars between Elkhart and Plymouth this fall and to extend the line to Chilton next spring.

PITTSBURG, PA.—The Pittsburg & Westmoreland Street Railway Company has asked McKeesport for franchises for a new road between points in Westmoreland County and McKeesport, giving direct street car connection with Pittsburg by way of McKeesport. William Fawcett, W. C. Soles, D. P. McCune and other McKeesport capitalists are interested.

CHATTANOOGA, TENN.—A scheme is on foot to harness the water power of the Ocoee and Hiawassee rivers. It is being backed by C. E. James, S. W. Divine and others. The scheme is said to carry with it plans for the consolidation of the properties of the two local street railways, and the operation of the cars by electrical power generated at the proposed Ocoee-Hiawassee plant.

PITTSBURG, PA.—Officials of the McKeesport & Clairton Railway Company say that the work of construction will be begun within two months. Right of way has been granted for the new road through the Borough of Portvue and the right of way through private property in Elizabeth township is now being secured. It is said that the money for the construction of the road is ready.

ST. LOUIS, MO.—It is announced that the officials of the St. Louis & Springfield Interurban Electric road have decided to construct their line on what is known as the Stauton route, building direct from Dorsey to Stauton and thence southwest through Worden, Hammel and other towns, the Bunker Hill route having been abandoned on account of the high prices asked for right of way.

MUSKOGEE, I. T.—The second electric railway to be put in operation in Indian Territory is to be built in this city by the Muskogee Traction Company, which is capitalized at $100,000. J. L. Reeves, the president of the company, has filed a plan of the road with the city clerk and says the line will be in operation with three miles of track by the first of next year. The only electric railway now operating in Indian Territory is at South McAlester, in the Choctaw nation.

ROCKVILLE, CT.—Preliminary plans for the Rockville, Broad Brook & East Windsor Street Railway Company have been nearly completed. The company is capitalized at $100,000. Most of the stock will be subscribed for by residents. All local franchises and rights of way have been secured, and the contract for building the line will soon be awarded. The road will be operated in close alliance with the Hartford & Springfield system, with whose line it will connect at East Windsor.

WHITE HALL, ILL.—Preliminary steps for the organization of the White Hall Railway Company have been taken. The purpose is to construct an electric line to the clay and coal fields about two and one-half miles east of the city. The first board of directors consists of E. S. Greenleaf, E. P. Kirbey, W. E. Killen and John R. Davis, Jacksonville; G. Bischoff, F. H. W. Krenning, Geo. W. Perry, St. Louis; A. P. Grout, Winchester; Jett A. Kirby, Jerseyville; H. O. Tunison and H. C. Morrow, White Hall. The capital stock is $40,000.

LOCKPORT, N. Y.—Reports are current here that certain Lockport business men, including William R. Kenan and Ralph Keep, backed by Henry M. Flagler, of New York, are planning to build a trolley line from Buffalo to Wilson and make Wilson harbor and the vicinity of Lake Island Park a summer resort. The proposed line is to run direct from Buffalo to Wilson, passing through North Tonawanda, Sanborn, Pekin, Cambria Centre and South Wilson. The road will have a private right of way, few stops will be made and fast time is scheduled for the run between Buffalo and the lake.

PHILADELPHIA, PA.—The contract for a model trolley power-house, to be located midway between Newtown Square and West Chester, has been awarded by the Philadelphia & West Chester Traction Company to John R. Wiggins, for $21,200. The building, which will be of brick, will be 107 feet in length and fifty-eight feet in depth, with reenforced concrete roof, the equipment of which will include steam turbines of large sizes, to drive the electrical generators. The building will accommodate three 450-horse-power boilers, and three steam turbines and electrical generators of 500-kilowatt capacity each.

TOLEDO, OHIO—President George B. Kerper, of the Toledo Uurban & Interurban Railway Company, says that the new line from Perrysburg to Toledo will be ready for operation by December 1. Negotiations have been completed whereby the Interurban tracks will pass under those of the Wabash, at Maumee, and over the tracks of the Clover Leaf, at the same place. According to present plans, the Interurban will connect with the Toledo, Bowling Green & Southern, a part of the same trolley system, south of the corporation line of Perrysburg. The Interurban will have its private right of way and the cars will not run through the town, as at present, but will go to the south and west entirely outside of the corporation limits.

NEW HAVEN, CT.—The Worcester & Blackstone Valley Street Railway has been sold to the New York, New Haven & Hartford Railroad Company. The sale was made and the purchase price paid at the office of the Blackstone Valley Company, in Worcester. The price was not given out. The officers of the company resigned and new officers were chosen. M. J. Whittal and Alfred Thomas, of Worcester, were the principal owners of the road, which was capitalized for $60,000. Its assets are over $460,000. The road is operated between Worcester and Whitinsville, a distance of nearly seventeen miles, and makes the third street railway entering Worcester to be bought by the New Haven road. The Worcester & Webster and the Worcester & Southbridge are now both New Haven properties.

SPRINGFIELD, OHIO—The Springfield, Washington, Chicago, Hamilton & Chillicothe Traction Company has elected the following officers: president, H. L. Rockfield; vice-president, Frank Patterson, New York; second vice-president, Lee M. Good; treasurer, A. M. Winger; directors: H. L. Rockfield, Lee M. Good, A. M. Winger, Ed. H. Ackerson, Springfield; Frank Patterson, New York; V. J. Dahl, Washington C. H.; Darwin Pierce, South Charleston; John Snyder, Enon. The new road will be parallel with the Detroit Southern to Washington, Chicago and Hamilton, and the Chicago, Hamilton & Dayton from that place to Chillicothe, touching the

towns of South Charleston, Jeffersonville, Luray and Austin. The line will ultimately be extended to McArthur and Athens, with a branch road to Pomeroy and Gallipolis.

SEATTLE, WASH.—W. E. Davidson, president of the Oregon Development Company, states that plans are being prepared for an electric line from Walloula to Union County, which will then be extended to Lewiston, Ida.

YOUNGSTOWN, OHIO—Articles of incorporation have been filed in Columbus for the Canton & Youngstown Electric Railway. The company proposes to build an electric line from Canton to Youngstown *via* Randolph. The line will be about fifty-five miles long.

AURORA, ILL.—The board of directors of the Aurora, DeKalb & Rockford electric line have let the contract for the construction to W. C. Ross & Company, of Chicago. The specifications call for the completion of the line so that it will be open for business next summer.

DANVILLE, KY.—The Fiscal Court of Boyle County has granted a franchise to Frank Snyder to build an electric railway from Danville to Junction City, a distance of five miles. The road will connect with the Louisville and Nashville and will be built at once.

ALBANY, N. Y.—The Auburn & Northern Electric Railroad Company, of Auburn, has been incorporated with a capital of $250,000 to operate a street surface road eight miles long from Auburn to Port Byron, Cayuga County. The directors include Edwin D. Metcalf, Charles P. Mosher, Orlando Lewis, Charles A. McCarthy, of Auburn, and Clifford D. Beebe, of Syracuse.

VACAVILLE, CAL.—A franchise has been awarded by the board of trustees for an electric road through Vacaville to J. W. Hartzel, of Vallejo, and his associates. Part of the system is now in operation and the new franchise is a link in the general plan of development in superior California. The line will follow the public road to Vallejo. The franchise is now complete for the entire route.

FAIRMONT, W. VA.—The Fairmont & Morgantown Traction Company has been incorporated with a capital stock of $50,000. Among the members of the company are: C. L. Barnes, W. T. Watson, John Pope, T. T. Holt. The company proposes to first construct a line from Fairmont to Montana, a coast town five miles from here, and follow the east side of the river exclusively. Later the line will be extended to Morgantown.

SIOUX FALLS, S. D.—S. C. Lee, A. R. Marshall, W. R. Marshall, J. R. Sheely and G. W. Rhine compose a Des Moines (Iowa) syndicate which has been granted a franchise for the construction and operation of an electric street railway system in Sioux Falls. It is expected that the work of constructing the system will commence in the course of the next few weeks. The same syndicate has also been granted a franchise for the construction and operation of a central heating plant.

HAMILTON, OHIO—The annual meeting of the Cincinnati, Dayton & Toledo Traction Company, held at the general offices of the company, resulted in the election of the following board of directors: George B. Cox, J. Benson Foraker, Jr., W. E. Hutton, L. A. Ireton, W. C. Sheperd, H. B. McGraw, C. C. Richardson, W. Kesley Schoepf and Peter Schwab. M. J. Mandelbaum and W. C. Lang, who heretofore represented the Cleveland interests in the corporation, retired from the directorate and Mr. McGraw was elected to represent the Cleveland stockholders.

LOUISVILLE, KY.—The property of the Highland Electric Railway Company, of New Albany, has passed into the possession of the Louisville & Southern Indiana Traction Company. The deal has been on for several months and was finally completed at a meeting of representatives of the two companies held in New Albany. The stockholders of the Highland company accept $10,000 of traction bonds for their Highland stock and bonds. The traction company will at once begin making repairs and improvements on the Highland line, which has not been in operation for nearly a year, and it was stated that cars will be running over the line within sixty days.

ALBANY, N. Y.—The Albion & Rochester Railway has been incorporated with a capital of $300,000 to build and operate a street surface railroad from Albion, Orleans County, to Lyell avenue, Rochester, a distance of twenty-eight miles. The Albion & Lockport Railway has also been incorporated to operate a street surface railroad twenty-five miles long from Albion to Lockport. The capital is $260,000. The directors of both of these companies are the same, as follows: A. K. Potter, of Lockport; Lorenzo Burrows and George B. Church, of Albion; E. C. Lufkin, Clark L. Ingham, Charles R. Hill and George H. Nickelo, of Buffalo; Reuben A. Adams, of Rochester, and Elisha Curtiss, of Sodus.

PERSONAL MENTION.

MR. ALBERT BECK, secretary of the Commercial Cable Company, who is traveling in Europe, will return about the first of November.

MR. CLAUDE S. CROCKER, lately superintendent of the electric plant at Kalgoorlie, Australia, was married recently to Miss Margaret Marmion, of Freemantle, Australia.

MR. FRANCIS H. KNAFF will install a modern district messenger service, similar to the American system, in Havana, Cuba, for the Havana District Telegraph Company.

MR. W. E. McKINNON has resigned his position as superintendent of the Electric Light and Waterworks, at Halletsville, Tex., and will accept a similar position at Coleman, Tex.

MR. H. M. DAVIS, advertising manager of the Sprague Electric Company, New York city, accompanied by his wife and daughter, is spending his vacation in St. Louis and eastern Kansas.

MR. A. H. YUNKER, formerly with the Edison Electric Illuminating Company, Boston, Mass., has been made superintendent of construction of the United Electric Light Company, of Springfield, Mass.

PRESIDENT W. R. HARPER, of the University of Chicago, has been decorated with the order of the Red Eagle of the second class, and Vice-president Judson with the Crown Order of the second class by Emperor William.

MR. J. D. LOVE, manager of the Home Telephone Company, Los Angeles, Cal., has resigned his position with this company and, it is understood, has left for his old home in Ohio. Mr. R. N. Crane has been installed as manager.

MR. R. D. ADAMS has been appointed manager of the San Antonio exchange of the Southwestern Telegraph and Telephone Company. Mr. Adams will assume his duties immediately, succeeding in this capacity Mr. M. F. Thomas.

MR. LINDSAY DUNCAN has resigned his position as professor of civil engineering in the University of Colorado to open an office in Denver. Mr. Duncan was formerly on the faculty of the College of Civil Engineering, Cornell University.

MR. CHARLES A. LIEB, who reorganized and rebuilt the street railways in Washington, D. C., and who was formerly consulting engineer of the General Electric Company, has been appointed mechanical director of the Manhattan Transit Company.

MR. HOWARD W. WEIDENER DUBOIS, a mining engineer of Philadelphia, has reported the discovery of platinum beds in the Rockies, 400 miles northeast of Vancouver. He has been investigating for the last four years for the United Gas and Improvement Company and Baker & Company, of N. Y.

MR. ELWOOD BRYAN, local manager of the Postal Telegraph Company, at Nashville, Tenn., has been promoted to the position of manager for the company at Memphis, Tenn. Mr. Bryan has been connected with the Postal company for twelve years, and for six years has been manager of the Nashville office.

MR. R. T. REID, manager of the Western Union Telegraph Company, Seattle, Wash., has been promoted to the superintendency of the second Pacific district, in place of Mr. T. W. Goulding, who has been transferred. The position vacated by Mr. Reid has been filled by Mr. A. T. West, manager at Port Townsend, Wash.

MR. A. W. LEONARD, superintendent of the Houghton County Electric Light Company, Houghton, Mich., has been appointed manager for the Houghton County Street Railway Company. Mr. Leon-

ard will be manager of both companies, and will be succeeded as superintendent of the light company by William McGrath, who has been the electrical engineer of the company.

DR. MICHAEL I. PUPIN read a paper on "The Problems of Electrical Engineering" at the electrical session of the recent meeting of the International Congress of Arts and Sciences in St. Louis. Dr. Arthur E. Kennelly presided at this meeting, reading a paper entitled "The Relation of Electrical Engineering to the Other Sciences."

MR. W. H. BOSSERT, of the Bossert Electric Company, Utica, N. Y., is making a trip through the West and South among the numerous supply houses handling its extensive line of specialties. He reports the prospect for good business as being extremely bright with sufficient orders already in hand to keep the factory busy.

SIR WILLIAM RAMSEY, on the evening of Tuesday, October 4, will be entertained at a banquet to be given by the scientific department of the Brooklyn Institute. This will be Sir William's farewell entertainment in this country as he sails on the following day. Professor Irving W. Fay, of the Polytechnic Institute, will preside.

MR. JAMES S. CUMMINGS, of St. Petersburg, Russia, who left the United States some years ago, has been making a tour of the American cities. He will sail in a few days on his return to Russia. Mr. Cummings has large contracts for conduit work in London and St. Petersburg, and it is for the completion of these that he now returns.

MR. LYMAN C. SMITH, of Syracuse, has given to Syracuse University an additional building for the College of Applied Science, which he established four years ago on a gift of $750,000. The new building will be three stories high and twenty by fifty feet, for mining, engineering and mechanical laboratories. The cost is estimated at something over $100,000.

ELECTRICAL SECURITIES.

As might have been expected, the feature of the stock market during the past week was the decline of the bullish movement inaugurated the week before last. For several days early in the upward movement, transactions reached a very high level, but, with the closing of the market for the week of September 17, there seemed evident a reaction. The week closing September 24 made this apparent, the market coming to a condition of irregularity and uncertainty, with a total net decline. It has been said that fully seventy-five per cent of the past week's transactions were the result of professional manipulation. The outside investors apparently did not take the bait, and by reason of the intense suspicion with which Wall street is regarded by the public, the brokerage and commission firms are still reporting an almost entire lack of business. There is little reason to believe, at the present time, that there will be any severe reaction. The very fact that the professional element could so bid up the market and then sustain it at this high level, gives proof of the stability of values in general. That powerful interests are behind the bull campaign is conceded even by the most pessimistic. There is still to come about the long-predicted autumn revival in trade. The country is coming to this revival, however, much more slowly than has been expected. Railroad earnings and bank clearings indicate improved general activity, and in some lines of industry the reports are favorable. The steel and iron trade, however, with additional cutting of prices, is not in such a satisfactory condition, and the coal industry is considerably behind its usual condition at this time of the year. The decision of Judge Gray, as arbitrer in the check weighmen's dispute, it is hoped will make for greater harmony in the coal fields. While Judge Gray, as umpire, decides that the miners should have check weighmen where they desire it, the wages of these weighmen must come from the miners themselves. This was practically what the employés desired, and as it does not impose any burden upon the operators, it will probably be received with general satisfaction.

ELECTRICAL SECURITIES FOR THE WEEK ENDING SEPTEMBER 24.

New York:	*Closing.*
Brooklyn Rapid Transit	54¼
Consolidated Gas	204½
General Electric	170
Interborough Rapid Transit	147
Kings County Electric	183
Manhattan Elevated	154
Metropolitan Street Railway	118½
New York & New Jersey Telephone	156
Westinghouse Manufacturing Company	180

The directors of the Westinghouse Electric and Manufacturing Company have declared the regular quarterly dividend of 2½ per cent on the preferred, assenting and non-assenting stocks. This is payable October 10 to stockholders of record September 30. Books close September 30 and reopen October 11.

Boston:	*Closing.*
American Telephone and Telegraph	140¼
Edison Electric Illuminating	258
Massachusetts Electric	58¼
New England Telephone	129
Western Telephone and Telegraph preferred	90

The Boston Elevated Railway Company will pay October 1 a dividend rental of $1.75 per share on the common stock of the West End Street Railway. West End Street Railway common transfer books closed September 22 and reopen October 3.

A dividend of $1.50 per share will be paid on October 15 to stockholders of record of the American Telephone and Telegraph Company at the close of business September 30. The transfer books will be closed from October 1 to 14, both days included. The company August instrument statement shows net output of 51,732 instruments, as compared with 17,429 a year ago, a gain of 34,303, or 200 per cent. This brings the total net output so far this year to 433,732 instruments, which is 26,303 more than the net output in the same period a year ago, and 3,764 more than in the same period of 1902. Last year was the year of the largest output in the history of the company, the net output being 629,195. If this year's net output exceeds that of last year, as now seems probable, the total number of instruments outstanding on December 31 will amount to about 4,500,000, compared with 3,779,517 on the corresponding date of 1903, 3,150,320 in 1902, and 2,535,606 in 1901.

The annual meeting of the stockholders of the Edison Electric Illuminating Company will be held at the offices of the company on October 11. Nothing other than routine business and the election of directors will take place.

Philadelphia:	*Closing.*
Electric Company of America	9¾
Electric Storage Battery common	62
Electric Storage Battery preferred	62
Philadelphia Electric	7
Union Traction	55⅞
United Gas Improvement	98½

The directors of the Electric Storage Battery Company have declared a dividend of 1¼ per cent from the net earnings of the company, on both common and preferred stocks, payable October 1 to stockholders of record at the close of business September 24.

At the annual meeting of the stockholders of the Union Traction Company the retiring board of directors was reelected. The stockholders ratified the merger into that company of various smaller lines, and also approved the placing of a mortgage of $1,000,000 on the property formed by the mergers.

Chicago:	*Closing.*
Chicago Telephone	122
Chicago Edison Light	152
Metropolitan Elevated preferred	61
National Carbon common	33
National Carbon preferred	106
Union Traction	7½
United Gas Improvement	31

The Northwestern Elevated annual meeting has been postponed indefinitely, and from now on the fiscal year will end June 30 and the annual meeting be held in the fall.

Metropolitan West Side Elevated Company's report for the year ended June 30 compares as follows: gross, $2,169,211; expenses, $1,020,280, leaving net of $1,148,931; other income, $8,904, making a total of $1,157,835; charges, $861,821, leaving a surplus of $296,014, as compared with $165,646 for 1903, and $214,604 for 1902.

NEW INCORPORATIONS.

STERLING, MICH.—Arenac Telephone Company. $6,000.

LANSING, MICH.—Banker Telephone Company. $10,000

WILMINGTON, DEL.—National Lighting Company. $500,000.

MONTGOMERY, ALA.—Enterprise Telephone Company. $15,000.

LANSING, MICH.—Grand Ledge Telephone Company. $10,000.

ATLANTA, GA.—Swainsboro & Statesboro Railroad. $350,000.

DECATUR, ILL.—Maroa Mutual Telephone Company. $10,000.

SPRING CREEK, KAN.—Spring Creek Telephone Company. $500.

NORTH BRANCH, KAN.—The Farmers' Telephone Company. $4,400.

INDIANAPOLIS, IND.—The Citizens' Telephone Company. Increased from $3,000 to $9,000.

DES MOINES, IOWA—Viele Independent Telephone Company. $3,000. Incorporators: R. C. Conlee and others.

CHICAGO, ILL.—Alton, Granite & St. Louis Traction Company. Changed to Alton Light and Traction Company.

POUGHKEEPSIE, N. Y.—Delaware & Scoharie Telephone Company. $2,000. Incorporators: H. P. Hubbell and others.

ST. PAUL, MINN.—Zumbro Falls Farmers' Telephone Company. $7,000. Incorporators: F. Robertson and others.

DES MOINES, IOWA—Spring Cedar Mutual Telephone Company. $5,000. Incorporators: Richard Gilbert and others.

NEW YORK, N. Y.—Interborough Electric Service Corporation. $40,000. Directors: P. K. McGonigal, W. F. Goldback, E. D. Brown, New York.

WASHINGTON, D. C.—Dalrymple Telephone and Electric Company. $200,000. Incorporators: George H. Corey, Eugene Schooley and J. L. Cohencius.

UNIONVILLE, IND.—Unionville Telephone Company. $399. Directors: George W. Welch, Milford Young, P. F. Lincicome, N. W. Lincicome and W. J. Slater.

LANSING, MICH.—Grand Ledge Telephone Company. $10,000. Incorporators: Clark Smith, W. H. Sutherland, D. Shadduck, A. H. Chapman and D. G. Kennedy.

LAPORTE, IND.—Laporte & Michigan City Traction Company. $400,000. Directors: A. D. Mallory, A. M. Hewes, Robert L. Henry, Isidore Spiro and Thomas Spence.

VALOIS, N. Y.—The Caywood, Lodi & Valois Telephone Company. $5,000. Incorporators: W. Traphagen, Caywood; Charles Marsh and Bert Van Vleet, Valois.

COLUMBUS, OHIO—Beach Telephone Company. $10,000. Incorporators: W. O. Miller, Levi Harruff, Joseph Klinefelter, Philip Ruehrmund and E. T. Tittelbough.

LINCOLN, NEB.—Lehigh Independent Telephone Company. $15,000. Incorporators: Frank E. Bell, H. W. Graves, H. P. Buhman, J. H. Sowery and Julius H. Pieper.

MORRILL, MINN.—Morrill Rural Telephone Company. $50,000. Directors: Henry Foss, Fred Cassidy, Aaron Montz, Guy Cowill, John Theon, C. S. Weigel and C. W. Bouck.

ALBANY, N. Y.—The Auburn & Northern Electric Railroad Company. $250,000. Directors: Edwin D. Metcalf and Charles P. Mosher, Auburn, and Clifford D. Beebe, Syracuse.

PRINCESS ANNE, MD.—Manokin Telephone Company. $5,000. Incorporators: R. R. Hoyt, Albert B. Fitzgerald, George W. Bozman, Isaac T. Parks, William L. Muir and Josiah P. Muir.

JERSEY CITY, N. J.—Dixon Home Telephone Company. $125,000. Incorporators: Charles N. King, W. Monds Green and Elmer H. Geran.

ALBUQUERQUE, N. M.—The Roswell Electric Light Company. $50,000. Incorporators: Edward A. Cahoon, of Roswell, and Alonzo B. McMillin and William R. Whitney, of Albuquerque.

RHINEBECK, N. Y.—Rhinebeck & Rhinecliff Street Railway Company. $60,000. Directors: Robert H. Hunter and J. L. Williams, of Poughkeepsie, and A. H. Hoffman, of Rhinebeck.

GUTHRIE, OKLA.—Enid Electric and Gas Company. $200,000. Incorporators: L. D. Turner, R. D. W. Holder, Belleville, Ill.; W. N. Horner, Chicago, Ill.; John C. Moore, and Clarence E. Rentchler, Enid.

COLUMBUS, OHIO.—The Springfield, Charleston, Washington & Chillicothe Railway Company. $50,000. Incorporators: Frank Patterson, Amaziah Winger, Edward H. Ackerson, John Snyder, Levi M. Goode.

AMERICAN FALLS, IDA.—American Falls Electric Company, Limited. $100,000. Directors: William and John Burke and S. V. St. Clair, of American Falls, and R. H. Johnson and S. H. Hays, of Boise.

EVANSVILLE, IND.—Evansville & Henderson Traction Company. $10,000. Directors: H. E. Randall, of Dayton; C. C. Tennis, Cincinnati; C. H. Batten, New Albany; E. H. Reitman, New Albany, and J. W. Pritchard, Evansville.

COLUMBUS, OHIO—The Canton & Evingston Railway Company. To build an electric railway passing through Clark, Portage and Mahoning counties. Incorporators: W. H. Clark, W. L. Davis, J. J. Whitacre, J. W. E. Monnett and L. D. Blanchard.

FREDERICK, MD.—People's Light and Heat Company. $3,500. Incorporators: John P. T. Mathias, Charles C. Waters, Frank Henson, Charles M. Mackley, Warner T. Grimes, Maurice J. Albaugh, James T. Waesche, D. R. Rouzer, M. L. Creeger, J. W. Creeger, George W. Stocksdale and I. W. Loy.

MAGNOLIA, MISS.—Magnolia Electric Railway and Power Company. To build, equip and operate an electric car line between Magnolia and Summit, taking in the towns of Fernwood, Whitestown and McComb City. $250,000. Incorporators: J. H. Price, C. V. Ratcliff, L. E. Schilling and others.

DANVILLE, ILL.—Hillsboro & Southwestern Railway Company. To build an electric railway from Hillsboro to Alton. $10,000. Incorporators: Frank P. Blair and Fred Chapman, of St. Paul, Minn.; Alexander W. Crawford and Charles C. Terry, of Girard, Ill., and Frank L. McDavid, of Hillsboro.

DOVER, DEL.—The Pinar del Rio Railway and Iron Company, of New York city. To construct, maintain and operate railways and telegraph and telephone lines. $1,000,000. Incorporators: Joseph Bailey, of Patchogue, N. Y.; Leonard L. Bishop, of West Hampden, N. Y.; Frederick D. Gillin, of Chicago, and Louis G. Cone, of Havana, Cuba.

EDUCATIONAL NOTE.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCE has published its prospectus for 1904-5. This contains the announcements of addresses, lectures, exhibitions and other meetings to take place during 1904-5. The instruction in this Institute is largely by lectures and the field covered is from architecture to zoology.

NEW PUBLICATION.

"EVERYDAY ELECTRICITY"—A recent publication in the field of electric journalism is *Everyday Electricity*, a monthly published by the Everyday Electricity Company, Limited, Manchester, England. The journal will attempt to cover the electrical field in a non-technical manner. Subscription price is threepence a copy.

ELECTRIC LIGHTING.

TACOMA, WASH.—The city is installing fifty additional arc lamps.

ABERDEEN, MISS.—The city council has purchased the electric light plant of E. M. and J. K. Jones.

EUGENE, ORE.—The Lane County Electric Company will furnish current for lighting to Springfield.

WAYNE, NEB.—An electric plant is to be installed. L. W. Roe is chairman of the city electric light committee.

HELENA, GA.—The city council is receiving bids for the construction of a system of electric lights and waterworks.

HAZLETON, PA.—Woodring & Company have been awarded the contract to install an electric light plant at Shenandoah.

SOUTHAMPTON, N. Y.—The Southampton Electric Light Company has been sold to the Suffolk Light, Heat and Power Company.

LAURENS, S. C.—It has been voted to issue bonds to the amount of $40,000 for the purpose of improving the waterworks and electric light plants.

SHENANDOAH, PA.—At a meeting of the stockholders of the Citizens' Electric Light Company it was decided to make a number of improvements to the plant.

COLUMBIA, S. C.—The Columbia Electric Light and Power Company has been granted a five-year franchise for street lighting. The city will pay $80 per lamp.

HAGERSTOWN, MD.—The town of Hancock, through which the Wabash extension will run, will be lighted with electricity by the Great Cacapon Power Company.

PITTSBURG, PA.—The United Electric Light Company, of Wilmerding, composed of Wilmerding capitalists, will furnish electric light to several of the towns in the Turtle creek valley during the coming winter. A plant has just been completed.

SHENANDOAH, IOWA—The deal has been completed by which the Artificial Ice Company gets possession of the entire plant of the Shenandoah Electric Light and Power Company, the price being $20,000. The officers of the company will remain the same: J. J. Dunnegan, president; George Bogart, treasurer; W. P. Crose, secretary.

HEALDSBURG, CAL.—The city trustees have for a second time accepted bids and awarded contracts for the construction of a new auxiliary electric power plant, which is to furnish power for the day system inaugurated September 1. The contract for the construction of engine and boiler was awarded to the Tracy Engineering Company. The contract for installing the electrical machinery was awarded to the Wagner-Bullock Company.

NORFOLK, CT.—The Norfolk Electric Light and Power Company, of this place, has leased its plant to the Canaan company, which was recently incorporated. Owing to a disagreement between the Electric Light and Power Company and the Canaan authorities, the streets of the town had not been lighted for several months, and the plant has not been in operation. The purpose of the new owners is to remodel and enlarge the plant and to operate it day and night.

ENGINEERING SOCIETIES.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA—The May issue of the proceedings of the Engineers' Society of Western Pennsylvania contains the following papers, "The Effects of the Baltimore Fire," by W. N. Hazen; "Commercial Gas Analysis in Stationary Hempel Apparatus," by H. C. Babbitt, and a topical discussion on forms and relative advantages of teeth in gears.

THE AMERICAN INSTITUTE OF ARCHITECTS—The American Institute of Architects has just issued the "Proceedings of the Thirty-seventh Annual Convention" held at Cleveland, Ohio. The frontispiece is a photograph of Mr. Charles F. McKim, president of the Institute. The quarterly bulletin of this society contains a report of the sixth International Congress of Architects, held in Madrid, Spain, April 6 to 13.

THE ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA—The paper read at the September meeting of the Engineers' Society of Western Pennsylvania was by Mr. Gerald E. Flannigan, descriptive of the Phipps Power Company, at Philadelphia. This paper is given in full in the "Proceedings of the Society," together with a series of line drawings and half-tones completely descriptive of the building.

SOCIETE DES INGENIEURS CIVILS DE FRANCE—The bulletin of the Societe des Ingenieurs Civils de France, for June, 1904, contains a short article on pneumatic traction for mines in the United States, by M. A. de Gennes, and a long study of the steam turbine and its applications, by M. G. Hart. The latter paper gives descriptions of all types of turbines which have thus far been put forward.

THE AMERICAN MATHEMATICAL SOCIETY—At the meeting of the American Mathematical Society held in room 1 in the hall of Congresses, St. Louis, last week, about thirty-five members were present, most of them professors of mathematics in American universities. Professor Alexander Zivet, of the University of Michigan, presided. Among those who presented papers were Professors L. D. Ames and G. A. Bliss, University of Missouri, and Professor E. B. Escott, University of Michigan.

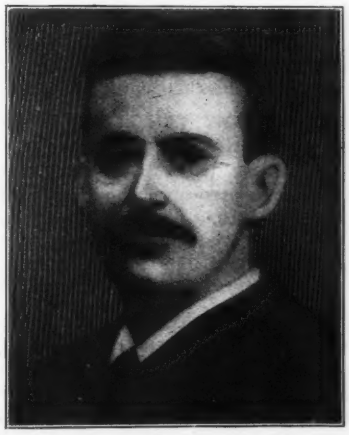
THE AMERICAN ROENTGEN RAY SOCIETY—The American Rœntgen Ray Society, during its convention at St. Louis, elected the following officers: president, Dr. Charles Lester Leonard, of Philadelphia; vice-presidents, Drs. Weston A. Price, Cleveland, Ohio; Henry Hulst, Grand Rapids, Mich.; Gordon G. Burdick, Chicago, Ill.; secretary, Dr. Russell H. Boggs, of Pittsburg, Pa.; treasurer, Dr. Levitt E. Custer, Dayton, Ohio. At this convention, lasting three days, a number of papers, important to both the electrical and medical fraternity, were read.

OBITUARY NOTICES.

MR. B. E. GREENE, formerly editor of *Electricity* and recently in the life insurance business, died suddenly at his home in Brooklyn, on Wednesday morning of this week. Mr. Greene was recently operated upon for cancer of the tongue.

COLONEL ALEXANDER MACOMB MILLER, of the corps of engineers, United States Army, while returning from an inspection of some government works, was suddenly stricken with heart disease on the steamer Potomac, near Irvington, Va., September 14. Colonel Miller had charge at the time of his death, of the Washington aqueduct, Potomac river, and the new filtration plant under construction at Washington, besides some important river and harbor work.

PROFESSOR NIELS R. FINSEN died at Copenhagen, Denmark, last week. Professor Finsen was a noted investigator into the methods of curing tuberculosis of the face with light rays, and was director of the Finsen Ray Institute in Copenhagen. For many years he had suffered from a complication of diseases, but his whole life seems to have been given up to the effort to alleviate the sufferings of others at the expense of his own. He was forty-three years old, and a native of one of the Faroe Islands. Professor Finsen was graduated from Copenhagen University in 1890. Three years later he published an article in a medical journal on "The Influence of Light on the Skin." This aroused general attention, because of the assertion that cases of smallpox could be cured by putting red curtains at the windows of the sick-room. The Finsen-ray treatment, through which the inventor had become world-famous, has been described at length in almost every technical journal. It was the subject of a lengthy discourse and a number of experiments at the joint meeting of the American Institute of Electrical Engineers and the American Electrochemical Society in 1903. In December, 1903, Professor Finsen received the Nobel medical prize from the Norwegian Parliament.



PROFESSOR NIELS R. FINSEN.

INDUSTRIAL ITEMS.

"THE BROOKLYN EDISON" for September, published in its usual neat style, takes for its leading article "Brooklyn's New Theatre, the Majestic." Photographs of the interior give excellent views of the theatre.

THE AMERICAN CONDUIT COMPANY, Chicago, Ill., has been awarded a contract by the Electrical Commission of Baltimore to furnish 200,000 feet of bituminized fibre conduit. This contract was awarded under strong competition.

THE DAYTON MANUFACTURING COMPANY, Dayton, Ohio, describes in catalogue No. 6 the Silvey storage battery and appliances. Among these are portable and car lighting cells, central station type, and a number of motor dynamos.

I. P. FRINK, New York, has had excellent success with the Frink system of patent reflectors for use in lighting show windows, floor cases and similar display fixtures. Recent installations in some of the largest stores East and West have shown the confidence of users in this line of reflectors.

THE WESCO SUPPLY COMPANY, St. Louis, in its August number of "The Live Wire" gives a good description and pictures of the combined World's Fair exhibit of the Wesco Supply Company and a number of apparatus and electrical material manufacturers, whose products are marketed by this company.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., is sending to its friends and patrons a large hanger, thirty-eight by fifty inches, illustrating some of the standard and special apparatus made by that company. It is arranged by bulletin numbers which will make it valuable for ready reference.

THAYER BROTHERS & COMPANY, New York, announces that, owing to the death of the senior partner, Mr. Henry L. Faris, of the firm of Faris & Thayer, that firm has been dissolved. The business will be continued under the name of Thayer Brothers & Company, the members of which are Mr. N. Townsend Thayer, John R. Thayer and Theodore V. Sand.

THE NEBRASKA ELECTRIC AND FIXTURE COMPANY, Omaha, Neb., has secured the contract for the complete installation of an electric light system at Geneva, Neb. Work will be commenced immediately. Mr. Paul W. Horbach is the president of the company, Mr. A. G. Munro, secretary, and Mr. E. J. Sullivan, vice-president and treasurer.

THE CAMBRIDGE SCIENTIFIC INSTRUMENT COMPANY, Cambridge, England, has issued list No. 25 entitled "Technical Thermometry." This is a new and revised edition of the catalogue issued by the firm some time ago entitled "The Measurement of Temperature by Electrical Means." List No. 25 contains a number of points of value to all people interested in the use and measurement of high temperatures, as well as specifications and prices.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., in the interest of automatic telephones has reprinted the annual report for the year ending June 30, 1904, of the Citizens' Telephone Company, Grand Rapids, Mich. It has also issued booklets entitled "What They Say About the Automatic in Grand Rapids," and "What Portland, Me., Thinks of the Automatic Telephone." Both of these booklets contain commendations by users of the automatic telephone apparatus.

THE STANDARD ELECTRIC MANUFACTURING COMPANY, Niles, Ohio, after exhaustive tests, has perfected a new lamp called the "Mill Type," and will soon be ready to make shipments. This lamp will be guaranteed for one thousand hours before dropping to eighty per cent of its initial candle-power. The filament is securely anchored, making the lamp of special value in the neighborhood of machinery. In addition to the "Mill Type" this company manufactures the "Star" lamp, which has been more than satisfactory in the past.

THE F. D. LAWRENCE ELECTRIC COMPANY, Cincinnati, Ohio, is making further enlargements in its store to accommodate a rapidly increasing business. The showrooms on West Fourth avenue are the most complete of any in the Central West, and one may find on display, neatly arranged, samples of everything required by the electrical contractor from the fixture to the engine-room switchboard. Okonite, Flexduct and Bossert specialties are some of the leading lines being pushed by this enterprising firm. Fall business is already brisk, but with the systematic methods of the Lawrence company prompt shipments are always made even in the busiest times.

THE JANTZ & LEIST ELECTRIC COMPANY, Cincinnati, Ohio, is making preparations to enlarge its manufacturing facilities to enable it to extend operations. With this in view it is seeking agency arrangements in the leading cities. The line at present comprises open and enclosed motors from one and one-half horse-power to forty horse-power; belted generators from five kilowatts to 150 kilowatts, and engine-type generators from twenty-five kilowatts to 125 kilowatts, all direct current. This firm enjoys the largest home trade of any local concern and the high character of its machines will no doubt make the work of broadening out easy and quick. It presents an opportunity for any one seeking a good agency for direct-current apparatus.

THE CONSOLIDATED ENGINE-STOP COMPANY, 100 Broadway, New York city, has secured an order from the government to equip the four engines in the Philippine power plant at the World's Fair, St. Louis, with the Monarch system of engine control. The Philippine power-plant equipment consists of 1,500 horse-power in engines—one Ball & Wood engine, two Shepherd engines, and one Phœnix Iron Works engine. The Consolidated Engine-Stop Company has also equipped the four large Westinghouse engines in Machinery Hall; the Hamilton-Corliss and the Harrisburg Foundry and Machine Company's Fleming four-valve engine, and the Greenwald Corliss engine, making seven altogether in Machinery Hall. These are equipped with the Monarch engine-stop and speed-limit system.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Chicago, has just received an order for a combination long-distance and rural line switchboard to be installed at Hopkinsville, Ky. This switchboard will be somewhat of a deviation from the usual form as it will be provided with means for trunking to both the Strowger and the Globe Automatic exchanges. At the same time service must be given on the American company's system of selective party lines. This company has recently equipped a number of cities and towns with telephone apparatus. Among them are Albany, Mo.; Hull, Iowa; Camden and Clio, Mich.; Egg Harbor City, N. J.; Beloit and Enterprise, Kan.; Baxley, Ga.; Monroe, La.; Overbrook, Kan.; Tina, Mo.; North Loup, Neb.; Abingdon, Ill.; Rebillo, S. D.; Litchfield, Minn.; Hartford, Ct.; Nashville, Ga.; Erie, Kan.; Newman's Grove, Neb., and Caro, Mich.

LEGAL NOTES.

THE SAFETY ARMORITE CONDUIT COMPANY, Pittsburg, Pa., has brought suit in the United States Circuit Court, for the Western district of New York, against the Clifton Manufacturing Company, Boston, Mass., for infringement upon its patent for cleaning and enameling pipe for use in electric iron armored conduits.

A PROXIMATE CAUSE OF ACCIDENT—In the case of Hale *vs.* the St. Louis Transit Company, the Supreme Court of Missouri held that the failure to stop a street car at the destination of a passenger by reason of which he was carried to the next street was not a proximate cause of his falling on the slippery pavement in the attempt to return to the point where he should have been permitted to alight.

DECREE FOR WESTINGHOUSE COMPANY—Judges Putnam, Aldrich and Brown, on September 9, 1904, handed down a decision in the United States Circuit Court of Appeals for the First Circuit, in the patent case of the Westinghouse Electric and Manufacturing Company *vs.* the Stanley Instrument Company, reversing the decree of the Circuit Court, which dismissed the plaintiff's bill. The suit was brought for an injunction to restrain the alleged infringement by the Stanley company of certain claims in patents issued to Nikola Tesla, relating to the conversion of alternating current into continuous current. The lower court held that the plaintiff had not established its claim, because there was a lack of supporting proofs. The opinion concludes: "The decree of the Circuit Court is reversed; the case is remanded to that court, with instruction to enter a decree in favor of the complainant for an injunction and an accounting, and to take such further proceedings as may be required not inconsistent with this opinion; and the appellant recovers the costs of this appeal."